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THE POTENTIAL OF USING THE EARLY EOCENE-OLIGOCENE COAL'S FORMATION IN TANJUNG BARITO BASIN

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ABSTRACT

Background: Research on the development of coal utilization for Indonesia is very important considering that Indonesia is a country that has large amounts of coal reserves, so it can use its coal not only as a source of energy for power plants but also needs to incentivize coal conversion for increased added value.
Aim: To analyze the potential of using the early Eocene-Oligocene coal's formation in Tanjung Barito basin
Method: In this study, data sources derived from laboratory test results will be analyzed by descriptive methods with quantitative approaches. The results of this study were obtained through proximate tests on coal samples TIAN-0 1 and TIAN-0 2 total value moisture of 9.1 4% weight as-received basis (arb) and Moisture in the Analysis sample worth 3.67%, value ash content 7.35%, flying substance value 36.11%, tethered carbon value 52.86% with air-dried base (ADB) basis % weight and total sulfur value 0.36% with air-dried base (ADB) % weight.
Findings: Based on the gross calorific value with an average caloric value of 7353 Kcal/kg, sample coal is classified as high volatile coal A bituminous. The results of testing on the potential of sample coal caking also indicate the potential utilization of Early Eocene-Oligocene coal Tanjung Formation to be used in the metallurgical industry with the results of testing the value of the Free Swelling Index sample showing the swelling ability of the coal with a value of 6 and 2.5 and G indexes 66 and 92.

KEYWORDS *coal quality, proximate, FSI, swelling*

INTRODUCTION

The quality of coal is determined by the content of organic and inorganic materials that make it up and its rank. Finding out its potential utilization is generally done through the interpretation of its characteristics. These characteristics can be known through laboratory tests of coal samples, including in the form of analysis of the physical and chemical characteristics of coal, namely through proximate analysis which among others is needed to find out the content of parameters such as moisture, flying substances (volatile matter)," total sulfur, solid carbon (fixed carbon), and ash content (ash). Other tests also need to be done to determine the potential for special utilization of coal samples, for example for gasification processes, liquidation, or as a material for conversion to metallurgical coke (Metallurgy coke) where for the benefit of early indications, crucible swelling number (CSN) and G Index values are commonly used.

Research on the development of coal utilization for Indonesia is very important considering that Indonesia is a country that has large amounts of coal reserves, so it can use its coal not only as an energy source for power generation but also needs to stimulate coal conversion for increased added value. The conversion is also indispensable for the fulfillment

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of industrial and general needs, such as the conversion of coal to gas, methanol, and coke/ coke. Therefore, the purpose of this study is to analyze the topic.

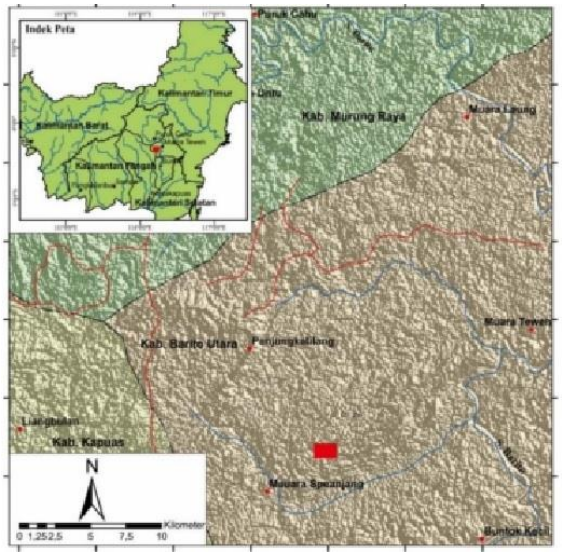
Tanjung Coal Formation is located in the Bario Basin, where the Bario Basin is located in the southeastern part of Kalimantan Island (Satyana et al., 2001). The Barito Basin is bounded by Meratus Mountain in the east and Schwaner Core in the west (Figure 2) (Satyana et al., 2001).

After Barito Basin was developed in the Late Cretaceous facilitated by the collision of the Schwaner Core micro-continent and Paternoster micro-continent (Satyana et al., 2001; Satyana & Silitonga, 1994). The deposition of carbonaceous material continued until the early Miocene and ended when there was the addition of clastic sediments from the west (Satyana & Silitonga, 1994). Synrift sequence in this basin is composed of Late Paleocene-Middle Eocene sediments namely Lower Tanjung Formation. This formation is composed of sediments of sandstone, siltstone, shales, and conglomerates, with a thin layer of coal. The change in sediment characteristics is very clear in the syn-rift and post-rift sequences. Based on well drilling data, the lower part facies and their thickness changes is local which indicates rift-infill, and the upper sequences of the sediments are a regional occurrence which indicated that they are more influenced by the irregularity horst and graben terrain (Satyana & Silitonga, 1994).

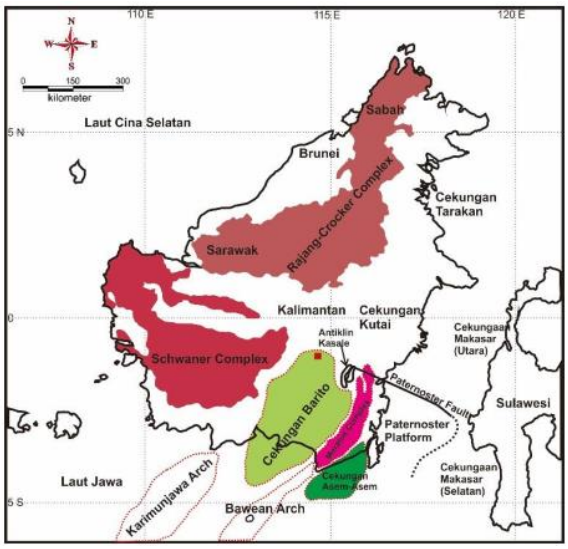
METHOD

Research field activities were carried out by sampling for coal outcrops research of Tanjung Formation, Barito Basin located in Lemo area, Central Kalimantan (Picture 1). The sample was taken using the channel sampling method ply by ply (Thomas, 2013). The sample is then tested in the laboratory and the test results will be analyzed and processed data with a descriptive method with a quantitative approach.

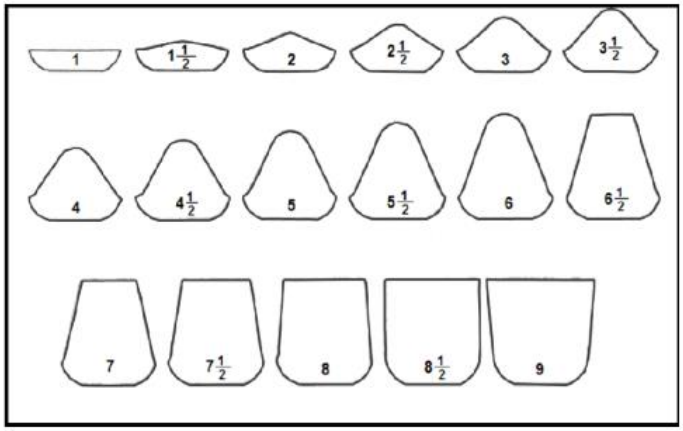
Batubara sample was also tested to discover its caking and swelling. The volume of swelling relies on how much coal plastic material melting, the swelling of gas-formed vacuoles, and the tension between solid particles and the fluid melting material in the coal, these things cause more gas to be trapped and lead the coal to swell. Swelling characteristic for coals in general increases following the coal rank. Values within a class for each coal rank individually differ significantly. Lower rank coal usually has a lower swelling value (Speight, 2015). In this test, the results of the swelling of coking coal in the test are compared with the profile of the swelling index numbers (Picture 3). All the results then analyzed withh the help of relevant sources from ASTM (ASTM D720-91, 2010a; ASTM D3174, 2004; ASTM D4239-04, 2004a, 2004b; ASTM D5373-13, 2013).



Picture 1. Coal Sampling Site for Research (Modification of Amijaya et al., 2019)



Picture 2. Kalimantan Island Physiography, Red Box Research Area (Amijaya et al., 2019)



Picture 3. Forms of Coal Free-Swelling Index (ASTM D720-91, 2010b)

RESULTS AND DISCUSSION

The data obtained from the results of laboratory tests of coal samples is the total value of moisture in air-dried, ash content, volatile matter, total sulfur, and fixed carbon. The coal sample consists of two samples, namely tian-0 1 sample and TIAN-0 2 sample. The results of the proximate analysis can be seen in Table 1, while the data obtained from the results of CSN, HGI, and G Index tests can be seen in Table 2.

For comparison of the results of proximate analysis of the sample used and analyzed in this study is also presented in the form of a graph, where the results of the proximate analysis can be seen in Figure 1 and the results of the CSN, HGI and G Index tests of the graph can be seen in Figure 2.

Based on the results of the analysis of proximate on TIAN-0 1 sample and TIAN-0 2 sample has Total Moisture values of 13.09 and 5.19%, Moisture In The Analysis sample worth 3.52 and 3.83%, Ash content worth 9.63 and 5.08%, Volatile Matter worth 31.61 and 40.61%, Fixed Carbon 55.24 and 50.48% and Total sulfur worth 0.4 and 0.33%.

Sample TIAN-02 in the test had a higher caloric value compared to the TIAN-0 1 sample with a value of 7519 Kcal / Kg compared to 7187 Kcal / Kg.

For testing the nature of coal swelling obtained a CSN value as an indication of swelling index 6 for tian-0 coal samples 1 and swelling index value of 2.5 for TIAN-02 coal samples with HGI value is 76 for TIAN-0 coal sample 1 and HGI value for TIAN coal sample- 02 is 39, while the G index value is 66 for the TIAN-0 coal sample 1 and the G index value for the TIAN-02 coal sample is 92.

Nilai Free swelling index 6 or higher from this index represents good coke-form. This also means that the higher the number higher the ability of coke forming. FSI is categorized from 1 to 9 depending on swelling capacities (Speight, 2015) categorized FSI into 3 main categories; weak (0-2), moderate (2 to 4), and strong (4 to 9).

Based on the test results mentioned earlier, it can also be known that Tanjung formation coal from The Barito Basin in North Barito, Central Kalimantan, is a high volatile A bituminous coal that has the potential to be utilized for the benefit of the metallurgical industry.

According to Speight (2015) and Miller (2005) the tendency of coal to caking will dramatically increase in the range of volatile matter between 25 to 35%, while the tendency of swelling in coal decreased with the increasing value of mineral matter (Figure 3).

Table 1. Proximate Analysis Result Data

Parameter Analysis	Code Sample		Unit	Basis	Standards
	TIAN-01	TIAN-02			
Total Moisture	13,09	5,19	Weight %	ARB	D3302/D3302M-19
Moisture in the Analysis sample	3,52	3,83	Weight %	ADB	D3173/D3173-17a
Ash Content	9,63	5,08	Weight %	ADB	D3174-12
Volatile Matter	31,61	40,61	Weight %	ADB	D3175-18
Total Sulfur	0,40	0,33	Weight %	ADB	D4239-18
Fixed Carbon	55,24	50,48	Weight %	ADB	D3172-13
Gross Calorific Value	7187	7519	Kcal/kg	ADB	D5865/D5865M-19

Table 2. Data on Physical Properties Analysis and Coal Swelling

Parameter Analysis	Code Sample		Unit	Standards
	TIAN-01	TIAN-02		
HGI	76	39		D409/ D409M-16
CSN	6	2,5		D720/D720M-15e1
G Index	66	92		ISO 15585:2019
Particle size + 50 mm	0,0	63,91	Weight %	D4749-87
Particle size - 50 mm	100,00	36,09	Weight %	D4749-87

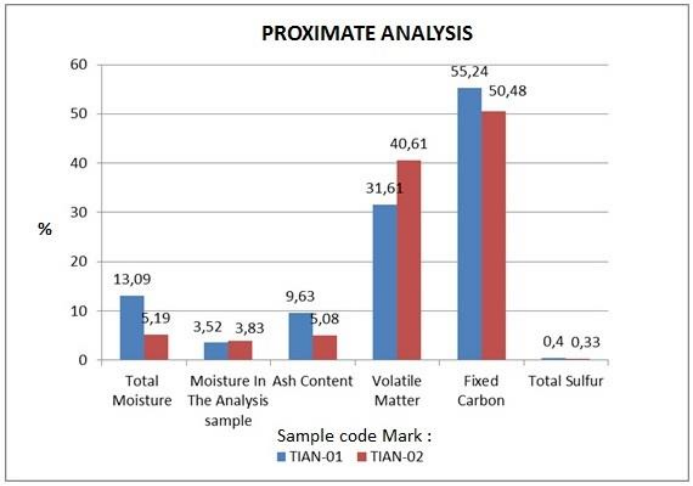


Figure 1. Coal Sample Proximate Test Result Analysis Graph

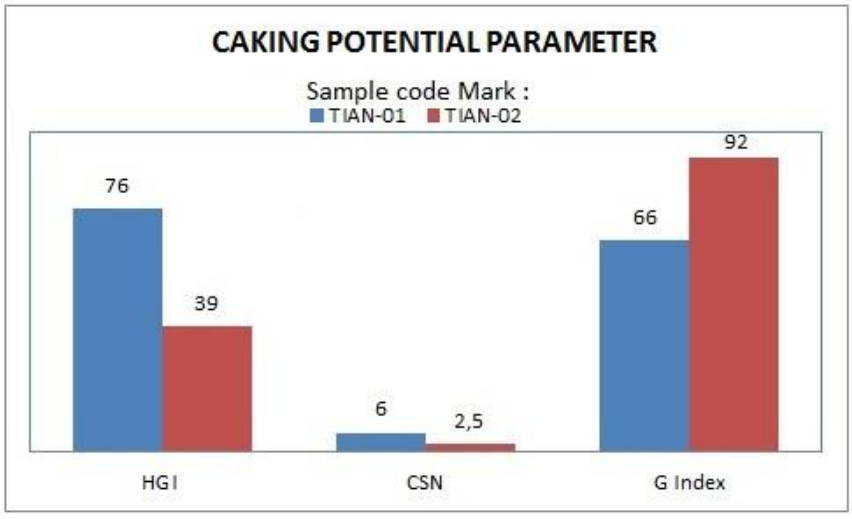


Figure 2. Coal Sample Caking Potential Parameter Graph

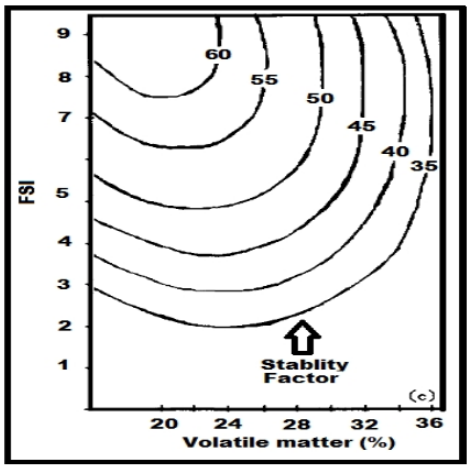


Figure 3. Relationship Between Volatile Matter, Freeswelling Index Value, and Coke Stability Factor (Gransden et al., 1991)

CONCLUSION

Tanjung Formation coal samples from the Barito Basin area of North Barito, Central Kalimantan analyzed in this study had Total Moisture values of 13.09 and 5.19%, with an average of 9.14% (arb), Moisture In The Analysis sample worth 3.52 and 3.83% with an average of 3.67%, ash content worth 9.63 and 5.08% with an average of 7.35%, Volatile Matter worth 31.61 and 40.61% with an average of 36.11%, Fixed Carbon 55.24 and 50.48% with an average of 52.86%, and Total sulfur worth 0.4 and 0.33% with an average of 0.36%. Based on the gross calorific value with a value of TIAN-01 worth 7187 Kcal/Kg and SAMPLE TIAN-02 are 7519 Kcal/Kg, sample coal is classified as high volatile coal A bituminous.

For testing the properties of coal swelling obtained A CSN value as an indication of swelling index 6 for TIAN-01 coal samples and swelling index value of 2.5 for TIAN-02 coal samples with HGI value is 76 for TIAN-01 coal sample and HGI value for TIAN-02 coal sample is 39, while G index value is 66 for TIAN-01 coal sample and G index value for TIAN-02 coal sample is 92.

The test results on the potential of sample coal caking also indicate the potential utilization of Early Eocene-Oligocene coal Tanjung Formation to be used in the metallurgical industry with the results of testing the value of the Free Swelling Index sample showing the swelling ability of the coal with values of 6 and 2.5. The value of 6 indicates strong swelling capacities.

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