CHARACTERISTICS, RANKING, AND POTENTIAL OF COAL ON SEAM H AND SEAM H2

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ABSTRACT

Coal is a complex solid object consisting of several chemical elements and comes from plants that are deposited in a basin. The South Sumatra Basin is a basin with the presence of the Muara Enim Formation which is known as a coal-bearing formation. In this research, secondary data was used in the form of proximate analysis, ultimate analysis, and combustion properties analysis results in determining the characteristics, ranking, and potential of coal in the research area. Based on ASTM D 388 – 05 classification, coal in seam H has a Subbituminous B Coal ranking, while seam H2 has a Subbituminous A Coal rating. Based on the parameters in assessing the coal potential use for coal-fired power plants according to Thomas, 2013 in Suhat, et al., 2020, coal in seam H and seam H2 does not support the utilizations, but solutions can be carried out in the form of rewashing sample, coal drying, and coal blending.

Keyword: coal ultimate analysis, coal proximate analysis, coal combustion properties, coal quality, coal-fired power plants, Muara Enim Formation.

INTRODUCTION

Thiessen (1974) defines coal as a complex solid material composed of various chemical elements and a highly intricate organic substance. It is a burnable sediment that ranges in color from dark brown to black and is formed through the biochemical, chemical, and physical decay of plants.

Coal is formed in two ways; the insitu theory and the drift theory (Krevelen, 1993 in Hernawan, 2022). The in-situ theory defines that coal is created from plants or trees that grew in the same place where the coal seam is formed. When these plants or trees died, they were buried under sediment layers and underwent the coalification process. On the other hand, the drift theory defines that coal is formed from plants or trees that were transported to the area where the coal seam is formed.

Seam H and H2 are located in the Macang Sakti area of the Musi Banyuasin Regency in South Sumatra Province. These seams are located in the Muara Enim Formation, also known as the Central Palembang Formation, which was deposited in environments ranging from shallow seas to land during the Late Miocene to Early Pliocene periods. This formation is known for its coal deposits and has a thickness ranging from 450 to 750 meters. It is made up of various types of rock, including claystone, clay sandstone, tuff, sandstones, siltstones, and coal seams. The deposition cycle in the Muara Enim Formation, according to De Coster in Purnama, 2010, is included in the regression phase in the South Sumatra Basin.

Stratigraphically, from old to young, rock units deposited in the South Sumatra Basin (modified from Gafoer, 1999 in Santy et al., 2012), are composed of the Lahat Formation, Talangakar, Gumai, Baturaja and equivalent, Air Benaka, Muaraenim, Kasai and equivalent, and the youngest volcanic rock deposits (Ranau and Bukitpunjung Formations), and above them are alluvium deposits as shown in figure 1.

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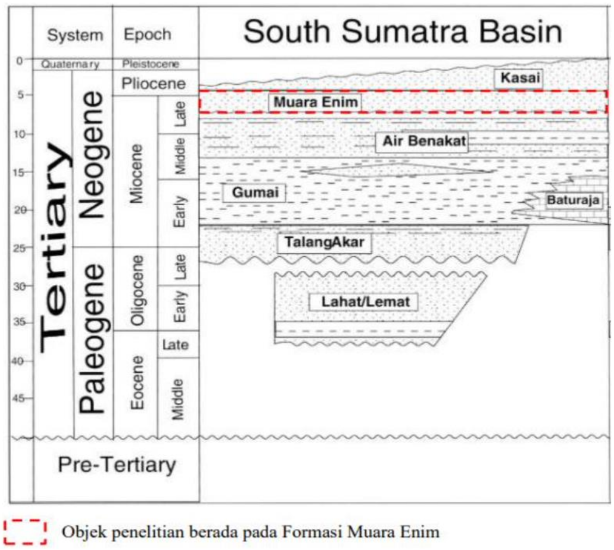

Figure 1. Stratigraphy of the South Sumatra Basin (Barber, et al., 2005)

Each region's coal has different characteristics. Analysis is conducted to determine their quality, rank, and potential. Several factors, including water content, ash, flying substances, solid carbon, total Sulphur, and calorific value, affect coal quality and ranking.

Table 1 shows the five coal ranks by ASTM (American Society of Testing Materials): peat, lignite, subbituminous, bituminous, and anthracite.

Table 1. ASTM Coal Rank D 388 - 05 Coal Classification

Class/Group	Fixed Carbon Limits (Dry, Mineral-Matter-Free Basis), %		Volatile Matter Limits (Dry, Mineral-Matter-Free Basis), %		Gross Calorific Value Limits (Moist,[B] Mineral-Matter-Free Basis) Btu/lb		Gross Calorific Value Limits Mj/kg[C]		Agglomerating Character
	Equal or Greater Than	Less Than	Greater Than	Equal or Less Than	Equal or Greater Than	Less Than	Equal or Greater Than	Less Than	
Anthracitic:									
Meta-anthracite	98	...	...	2	...	...	...	...	nonagglomerating
Anthracite	92	98	2	8	...	...	...	...	nonagglomerating
Semianthracite[D]	86	92	8	14	...	...	...	...	nonagglomerating
Bituminous:									
Low volatile bituminous coal	78	86	14	22	...	...	...	...	commonly agglomerating[E]
Medium volatile bituminous coal	69	78	22	31	...	...	...	...	commonly agglomerating[E]
High volatile *A* bituminous coal	...	69	31	...	14 000[F]	...	32.557	...	commonly agglomerating[E]
High volatile *B* bituminous coal	...	...	...	...	13 000[F]	14 000	30.232	32.557	commonly agglomerating[E]
High volatile *C* bituminous coal	...	...	...	...	11 500	13 000	26.743	30.232	commonly agglomerating[E]
					10 500	11 500	24.418	26.743	agglomerating
Subbituminous:									
Subbituminous *A* coal	...	...	...	...	10 500	11 500	24.418	26.743	nonagglomerating
Subbituminous *B* coal	...	...	...	...	9 500	10 500	22.09	24.418	nonagglomerating
Subbituminous *C* coal	...	...	...	...	8 300	9 500	19.30	22.09	nonagglomerating
Lignitic:									
Lignite *A*	...	...	...	...	6 300[G]	8 300	14.65	19.30	nonagglomerating
Lignite *B*	...	...	...	...	...	6 300	...	14.65	nonagglomerating

The properties of coal play a significant role in determining its suitability as a fuel for coal-fired power plants. A Steam Power Plant uses steam to generate electricity by converting its kinetic energy into electrical energy through a generator connected to a turbine. To spin the turbine, hot steam is required to provide kinetic energy. The initial stage of energy conversion in a power plant involves transforming the fuel into heat energy.

According to Thomas, 2013 in Suhat, et al., 2020, there are several parameters and limitations in assessing the potential of coal used for coal-fired power plants, including coal with a gross calorific value in the range of

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5000 kcal / kg (ar), moisture content below 36% (ar), ash content below 15% (adb), volatile matter content in the range of 40% (adb), and sulfur content below 0.9% (adb).

To assess the potential of coal for coal-fired power plants, it is important to ensure that the parameters and limitations are met. If there is a lack of conformity, there are several solutions that can be implemented to improve the quality of the coal. These include rewashing the samples, drying the coal, and blending different types of coal. Sample rewashing is typically done when coal has a high ash content, which is considered an impurity. Coal drying involves using heat energy from superheated steam to remove excess moisture from the coal. Coal blending is used to adjust the quality parameters of the coal to meet the expected criteria by mixing different types of coal with similar or different qualities (Amsya & Pelita, 2019, in Wibowo, et al, 2020).

RESEARCH METHOD

In this study, the method used was secondary data from drilling and laboratory analysis conducted by the Balai Besar Pengujian Mineral dan Batubara (BBPMB) tekMIRA. The laboratory analysis results are then processed so that the characteristics, rankings, and potential of coal from seam H and H2 are known.

RESULT AND DISCUSSION

Coal Research Area

Based on the stratigraphic column, the research area is composed of lithology which is quite diverse, including sandstone, claystone, siltstone, coally claystone, and coal. The following table 2 is data on the characteristics of coal in the study area.

Table 2. Characteristics of Coal Research Area

Seam	Sample Name	Proximate Analysis					Ultimate Analysis				
		M	Ash	VM	FC	TM	C	H	N	TS	O
		% (adb)					% (ar)	% (adb)			
H	MCS - C - 16	15.49	9.4	36.26	38.85	33.4	54.85	5.61	1.37	0.53	28.24
H2	MCS - B - 15	12.72	27.05	31.64	28.59	23.21	45.53	4.71	1.05	0.77	20.89
	MCS - B - 16	10.76	30.97	29.86	28.41	24.39	42.95	4.37	0.99	0.97	19.75

Characteristics of Coal Research Area Based on Proximate Analysis Results

In seam H and H2, there were three samples taken, namely MCS - C - 16, MCS - B - 15, and MCS - B - 16.

The moisture content in these seams ranges from 10.72% (adb) to 15.49% (adb). The appearance of water content in coal samples triggers inhibition of the combustion process of the coal.

The ash content in these seams ranges from 9.4% (adb) to 30.97% (adb). Ash content can inhibit the combustion process of the coal.

The content of volatile matter in these seams ranges from 29.86% (adb) to 36.26% (adb). The higher the volatile matter content, the faster the coal can burn.

The fixed carbon content in these seams ranges from 28.41% (adb) to 38.85% (adb). Fixed carbon is a component of coal that produces heat during the combustion process.

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The total moisture content in these seams ranges from 23.21% (ar) to 33.4% (ar).

Characteristics of Coal Research Area Based on the Results of Ultimate Analysis

The carbon content in these seams ranges from 42.95% (adb) to 54.85% (adb). Carbon content is the most burned component of coal during the coal combustion process.

The hydrogen content in these seams ranges from 4.37% (adb) to 5.61% (adb).

The nitrogen content in these seams ranges from 0.99% (adb) to 1.37% (adb).

The sulfur content (total sulfur) in these seams ranges from 0.53% (adb) to 0.97% (adb).

The oxygen content in these seams ranges from 19.75% (adb) to 28.24% (adb).

Coal Ranking Research Area

Based on ASTM D 388 classification, coal in seam H and H2 has a ranking that varies between subbituminous A coal to subbituminous B coal with a gross calorific value ranging from 10432 btu.lb (mmmf) to 10867 btu.lb (mmmf).

Coal Potential Research Area

Based on the specifications of coal that are used in coal-fired power plants (Thomas, 2013 in Suhat et al, 2020), seam H and H2 do not support the utilizations to be used for coal-fired power plants fuel (table 2). However, solutions can be made in the form of sample rewashing, coal drying, and coal blending on samples in the seam.

Table 2. Coal Potential of Research Area

Seam	Sample Name	Gross Calorific Value	Total Moisture	Volatile Matter	Ash	Total Sulfur	Coal Potential for Thermal Power Station	Solution
		cal/gr.ar	ar	adb				
H	MCS - C - 16	3930,00	33,4	36,26	9,4	0,53	No	Coal Blending
H2	MCS - B - 15	4274,00	23,21	31,64	27	0,77	No	Re-washing Sample & Coal Drying
	MCS - B - 16	4584,00	24,39	29,86	31	0,97	No	Re-washing Sample & Coal Drying

CONCLUSION

Based on the research that has been done, it can be concluded that:

a. Based on the results of proximate analysis on seam H and H2, the moisture content ranges from 10.72% (adb) to 15.49% (adb); ash content ranges from 9.4% (adb) to 30.97% (adb); volatile matter content ranges from 29.86% (adb) to 36.26% (adb); fixed carbon content ranges from 28.41% (adb) to 38.85% (adb); and total water content (total moisture) from 23.21% (ar) to 33.4% (ar).

b. Based on the results of ultimate analysis on seam H and H2, carbon content ranges from 42.95% (adb) to 54.85%; hydrogen content ranges from 4.37% (adb) to 5.61% (adb); nitrogen content ranges from 0.99% (adb) to 1.37% (adb); sulfur content (total sulfur) ranges from 0.53% (adb) to 0.97% (adb); and oxygen content (oxygen) ranges from 19.75% (adb) to 28.24% (adb).

c. Based on ASTM D 388 classification, coal in seam H and H2, coal has a ranking that varies between subbituminous A coal to subbituminous B coal.

d. Based on the specifications of coal that are used for coal-fired power plants (Thomas, 2013 in Suhat et al, 2020), samples in seam H and H2 do not support being used in coal-fired power plants. However, solutions can be made in the

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form of sample rewashing, coal drying, and coal blending.

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