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Study of Coalbed Methane (CBM) in Muara Air Lawai, Lahat, South Sumatra and Air Dingin, Sawahlunto, West Sumatra

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SUMMARY

This research was conducted in Muara Air Lawai, Lahat that belongs to the South Sumatra basin, which is one of major coal basins in Indonesia. To compare some samples were also collected from Air Dingin, Sawahlunto, a region in Ombilin basin which famous for its high rank coal. Coal samples were obtained from the core drilling in both areas of research. This research is aimed to determine the methane content in the coals in relation to basic coal characteristics inferred by proximate and petrographical analyses. Analysis of gas content in coal is performed by measuring lost gas (Q1), desorbed or measured gas (Q2), and the residual gas (Q3), while the gas composition was measured by a gas chromatographer. Coal samples from Muara Air Lawai and Air Dingin are classified as lignite and bituminous coals, respectively. In general, variation of methane contents in both coals are related with moisture content, vitrinite mineral composition, and coal ranks. Methane content in Muara Air Lawai coal is around 0.001 - 0.664 m³/ton and interpreted to be biogenic, whereas that of Air Dingin coal (5.58 - 12.95 m³/ton) is suggested to be a mixture both biogenic and thermogenic methane.

Introduction

Indonesia has a huge potential of coalbed methane resources, around 453.3 TCF (Outlook Energi Indonesia, 2010) spread over several main coal basins, such as South Sumatra Basin, Central Sumatra Basin, Barito Basin, Kutai Basin, and another basins known for its high rank coal named Ombilin Basin. This research conducted in Muara Air Lawai, Lahat that belongs to the South Sumatra Basin and in Air Dingin, Sawahlunto, a region in Ombilin basin. This research aims to determine the methane content in coal related to coal characteristics in both area.

Methods

Drill sampling with full coring method was taken in order to obtain coal samples. Laboratory analysis regarding coal characteristics such as proximate analysis, petrography analysis, calorific value analysis, and specific gravity analysis has been conducted on selected samples of coal from the core. Analysis for gas content in coal is done by measuring its lost gas (Q_1), desorbed or measured gas (Q_2), and the residual gas (Q_3) according to the American Standard ASTM D7965-10. These desorbed gas were then analyzed by gas chromatographer to obtain gas composition data.

Result and analysis

According to ISO 11760:2005, coal samples from Muara Air Lawai are classified as low rank B or lignite B coal, and coal samples from Air Dingin are categorized as medium rank C or bituminous C coal.

The correlation between depth, coal characteristics (total moisture, ash content, calorific value, vitrinite maceral composition, and vitrinite reflectance), gas content, and methane content are shown in Figure 1 (for coal samples from Muara Air Lawai, Lahat) and Table 1 (for coal samples from Air Dingin, Sawahlunto). High amount of moisture influences the adsorption capacity of coal seam as the organic component prefers to adsorb water instead of gas (Bustin and Clarkson, 1998). Moisture content may vary according to the rank of coal and coal composition, while methane adsorption also dependent on the change of these two variables.

The relationship of moisture content and methane content indicates that generally the reduction of moisture content increases the methane content in both coal samples. The correlation coefficient between these two variables for coal samples from Muara Air Lawai is 0.0146. This value does not designate a significant correlation, since the range of values for total moisture on each sample of coal somehow trivial. However, compared to coal samples of Air Dingin that have lower total moisture, thus the range of total moisture values is large enough, a negative correlation among these two variables can be better shown and made it clear that moisture affects the methane content in coal. The lower the total moisture, the higher the methane gas contained within the coal be.

Parameter	Coal Seam	
	B	C
Gas Content (m³/ton)	6.13	10.08
Methane Content (m³/ton)	5.15	6.19
TM (%ar)	6.77	5.14
Ash (%adb)	7.18	4.02
CV (cal/gr, adb)	7434	7646
Vitrinite (%)	96.0	95.4
Rv (%)	0.66	0.75

Figure 1. Correlation between depth, gas content, methane content, total moisture, ash content, calorific value, vitrinite maceral composition and vitrinite reflectance from coal samples in Muara Air Lawai, Lahat; Table 1. Gas content, methane content, and several coal characteristics for coal samples in Air Dingin, Sawahlunto

The presence of ashes in coal layers also lowering gas content as well as methane content. Ash reduces the ability of coal to adsorb gas, because ashes (minerals) in coal averse to adsorb gas. For coal in Muara Air Lawai, the correlation coefficient between ash content and methane content is calculated as 0.0157. This number does not demonstrate a significant relation for both variables, despite the values of ash content are diverse and have a fairly large span. This means that variations in methane content of coal from this region are not directly affected by the existence of ash. In comparison to coal samples from Air Dingin, it can be seen that coal seam with low ash content has relatively more methane gas.

A higher amounts of vitrinite maceral increase gas content in coal seam. The correlation coefficient for coal samples in Muara Air Lawai is obtained as 0.3234. This value does not adequate to signify a relation, but it shows a positive correlation between these two variables. Meanwhile, coal samples from Air Dingin show a different trend, but it does not necessarily taken into account, as the percentage of vitrinite maceral components between two coal seams in Air Dingin only 0.6% different. So, the effect of vitrinite maceral composition is not very clear. However, it can be seen that generally the composition of vitrinite maceral in coal affects the volume of methane contained in the coal.

According to Wandless (1960) and Millott (1942), the capacity of gas storage in coal elevates along with the increasing of coal rank (indicated by the raising value of vitrinite reflectance and calories). The correlation coefficient between vitrinite reflectance and methane content in Muara Air Lawai takes on 0.3385. Additionally, the coefficient of correlation for methane content and calorific value falls at 0.1209. If coal reaches 0.5 to 0.6% of vitrinite reflectance number, thermogenic methane gas began to form (Clayton, 1998) and relatively boosted the total amount of methane in coal. Therefore, as expected, methane content in coal samples from Air Dingin is greater than that of Muara Air Lawai. Furthermore, methane gas from Air Dingin is a mixture of biogenic and thermogenic methane, whereas those from Muara Air Lawai are purely biogenic methane.

Conclusion

1. Coal samples from Muara Air Lawai are classified as lignite or low rank coal, while coal samples from Air Dingin are categorized as bituminous or medium rank coal.
2. Coal rank affects the amount of methane content in coal (associated by high vitrinite reflectance and calorific value). High rank coal in Air Dingin has greater amount volume of methane (3.58 - 7.51 m³/ton) compare to coal in Muara Air Lawai (0.001 - 0.664 m³/ton).
3. The characteristics of coal that affect gas and methane content in coal in this particular area of research are vitrinite maceral composition and total moisture. The higher the coal rank (high vitrinite reflectance and high calorific value) and the dominance of vitrinite maceral has a positive relationship to the increasing number of methane content in coal. On the other hands, the presence of water reduces the amount of methane that can be adsorbed by the pores of the coal.
4. The type of methane gas in Muara Air Lawai is purely biogenic methane, whilst methane gas in Air Dingin is a mixture between biogenic and thermogenic methane.

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