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# Determination on Methane Gas in Place in Coal Seam by using Volumetric Method at X Field, East Kalimantan, Indonesia

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**Abstract.** PT. Virginia Indonesia Company (PT. VICO) is one of the oil and gas company which production of coal bed methane. The company is located in East Kalimantan province with the basin are processes namely Kutai Basin. Calculation of methane gas in place of coal bed can be done by several methods such as : material balance, volumetric and desorption test. Each method has its advantage and disadvantages. The method that used by PT. VICO to calculate gas in place at the moment is only the method of material balance. By using that method for calculating gas in place considered less accurate. Therefore we need other method of calculation of gas in comparison and evaluation of whether the value obtained relatively the same. One method of calculation, named volumetric method. This research will analyze the determination of the methane gas in place of coal using a volumetric method at Mutiara field PT VICO, East Kalimantan. The result of this study can be used as a reference company for comparison calculation which method already exists.

## 1. Introduction

Coal methane gas, known as coal bed methane, is shallow gas that is trapped and accumulates in coal pores during coalition period (Pertamina Hulu Energi, 2011). The potential of coal methane gas resources in Indonesia reaches 453.3 TCF, spread in 11 basins which are located in South Sumatra at 183 TCF, Barito 101.6 TCF, Kutai 80.4 TCF and Central Sumatra 52.5 TCF (Ministry of Energy and Mineral Resources, 2012).

PT. Virginia Indonesia Company (PT. VICO) is an oil and gas company that conducts exploration and production of coal bed methane. The company is located in the province of East Kalimantan with the processed basin area, the Kutai basin.

Calculation of gas in place of coal methane gas can be done by several methods including: material balance, volumetric and desorption tests [1]. Each method has advantages and disadvantages of each [2]. The method used by PT. VICO to calculate gas in place at this time is only the material balance method.

The use of one method to calculate gas in place is considered inaccurate. Therefore we need another method of calculating gas in place as a comparison and evaluation whether the values obtained are relatively the same. One such calculation method is the volumetric method [3]. This final project research will analyze the determination of coal methane gas in place using volumetric methods at the Pearl PT VICO field, East Kalimantan. The results of this study can be used as a company reference as



a comparison of existing calculation methods.

## 2. Method

The research took place on April 1 to April 30, 2016. The research stage began with the study of literature to obtain literature and related references that support research which can be derived from books and scientific journals.

The stages of the study continued with the collection of necessary data. Data was collected in Mutiara Field, East Kalimantan and PT. Indo Core Lab in Cilandak, South Jakarta. Required data are coal gas content, coal seam thickness, coal depth position, coal density, and coal methane gas percentage.

After the data is obtained, data processing will then be performed. The study consists of several variables, so the raw data obtained is then calculated using formulas obtained from the literature such as:

### 2.1. Calculate the volume of gas (VSTP)

Calculation of gas volume under Standard Temperature and Pressure conditions (STP: 60 ° F, 29.92 inHg) is obtained with use the ideal gas formula [4] in Equation 1 as below:

$$V_{stp} = \frac{P_{ambient} \times V_{ambient} \times T_{STP}}{T_{ambient} \times P_{STP}} \quad (1)$$

Information:

VSTP = volume measured in standard pressure and temperature.

Vambient = volume measured at room temperature

PSTP = pressure at standard conditions (29.92 inHg) Pambient = pressure at room temperature

TSTP = temperature at standard state (60°F)

### 2.2. Calculate the measured gas volume (Q2)

Calculation of measured gas volume (Q2) with headspace correction based on the Ryan and Dawson formula [5] is done in 2 steps as follows:

2.2.1 Calculate headspace volume by canister volume [6] with coal sample volume with Equation 2 as below:

$$\text{Sample volume} = \text{canister volume} - \text{sample volume} \quad (2)$$

2.2.2 Calculate the coefficient (K) calculated by Equation 3 as follows:

$$K = \frac{P_{kamar} \times T_{TSP}}{P_{TSP} \times T_{kamar}} \quad (3)$$

Information:

PSTP = pressure at standard conditions (29.92 inHg)

TSTP = temperature at standard conditions (60 ° F)

### 2.3. Calculate the measured value of gas without hydrogen content

Calculation of measured gas value without hydrogen content by the % H2 method [7] was obtained using Equation 4 as below:

$$\text{Gas content without H2} = \text{Direct measured gas} - (\text{Direct measured gas} \times \% \text{ H2}) \quad (4)$$

Information:

Direct measured gas = total volume of measured gas obtained directly based on the results of tests in the laboratory

% H2 = Level or percentage of hydrogen content contained in CBM

## 2.4. Calculate gas in place

After getting the amount of gas that is adsorbed in the form of scf / tonne [8] and getting the content of methane gas in the form of % [9] then it will then be calculated with other variables obtained based on the data obtained, namely: coal seam thickness, area area, average coal density [10] with Eq. 5 as below:

$$G=1359.7 \times A \times H \times pc \times GC \quad (5)$$

Information:

G = gas in place (scf)

A = Extent of reservoir (acre)

H = net thickness of reservoir layer (feet)

Pc = Ash free coal density (gr / cc)

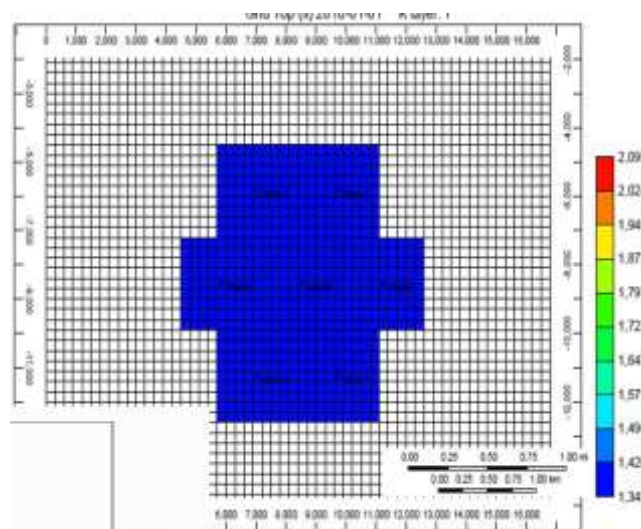
GC = Gas content (scf / ton)

## 3 Results

### 3.1. Determine the gas content in place based on well samples

The coal seams found in each well sample are at different depths. The depth of the coal seams found in the pearl field lies in the depth of 1500-5000 ft. For the area in the calculation of gas in place in 5 samples of the same well, which is obtained based on well spacing which has an area of approximately 160 acres (can be seen in Figure 1) and it is assumed that the coal seam continues.

There are 5 samples of wells used to determine the gas content in place, namely MUT 127, MUT 128, MUT 129, MUT 130 and Mut 131. The content of gas in place was calculated using Equation 5. Obtained in Table 1. The content of gas in place in each coal seam in each sample. Analysis can be done based on the results of gas in place and in this study the analysis is done by comparing the gas content in place with the position of the depth and the content of gas in place with the thickness of the coal layer which is adjusted with the theoretical basis and references that already exist.



**Figure 1.** Area Determination with Well Spacing

**Table 1.** The content of gas in place in each coal seam in each sample

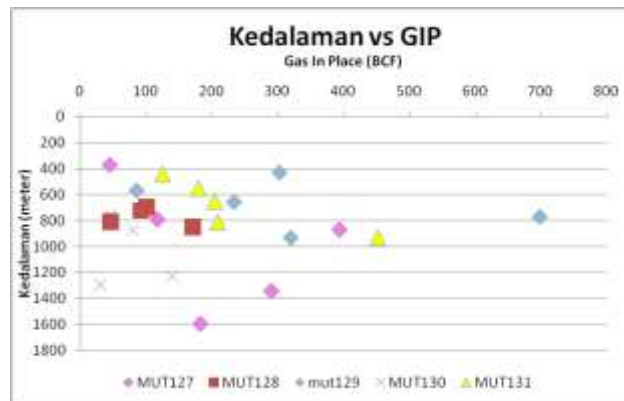
Layer Coal	Depth (M)			Mass type (g/cc)	Area (acre)	Gas in place (BCF)	Thick k (ft)
	Top	Bottom	Uji				
MUT127-A	369	370.8	369.9	1.43	160.0	45.7364	6.0
MUT127-B	790.59	792.1	791.3	1.20	160.0	118.076	5.0
MUT127-C	869.01	871.05	870.0	1.27	160.0	393.894	6.8
MUT127-D	1342.6	1344.7	1343.	1.27	160.0	290.724	7.0
MUT127-E	1596	1597.8	1596.	1.31	160.0	183.021	6.0
MUT128-A	693.19	694.56	693.9	1.22	160.0	101.273	4.6
MUT128-B	720.81	721.71	721.3	1.31	160.0	92.9363	3.0
MUT128-C	807.61	808.06	807.8	1.32	160.0	46.5449	1.5
MUT128-D	847.86	849.69	848.8	1.36	160.0	171.963	6.1
MUT129-A	426.04	428.16	427.1	1.33	160.0	302.718	7.1
MUT129-B	566.01	566.58	566.3	1.31	160.0	85.7409	1.9
MUT129-C	654.66	656.24	655.5	1.28	160.0	233.748	5.3
MUT129-D	768.36	770.73	769.5	1.38	160.0	698.255	7.9
MUT129-E	931.65	932.85	932.3	1.29	160.0	319.694	4.0
MUT130-A	753.9	755.7	754.8	1.31	160.0	47.4637	6.0
MUT130-B	875.47	876.09	875.8	1.25	160.0	80.4805	2.1
MUT130-C	1228.5	1229.7	1229.	1.16	160.0	140.533	4.3
MUT130-D	1295.1	1295.7	1295.	1.31	160.0	31.7038	2.1
MUT131-A	439.2	440.39	439.8	1.28	160.0	125.419	4.0
MUT131-B	548.43	549.93	549.2	1.36	160.0	179.856	5.0
MUT131-C	648.72	649.35	649.0	1.30	160.0	204.486	2.1
MUT131-D	810.24	811.44	810.8	1.24	160.0	209.163	4.0
MUT131-E	925.08	926.82	926.0	1.28	160.0	452.619	5.8

### 3.2. Effect of the position of the depth of coal on the content of gas in place

The position of the depth of the discovery of coal in each well sample is different. Each coal layer will produce different in-place gas contents, this is due to the different absorption capacity of methane gas along with the depth position of the discovery of coal.

Coal seams at depths of less than 300 m will cause methane gas to be released easily into the air so that it cannot be expected to be stored in coal properly, whereas at depths of more than 1000 m the coal absorption capacity will be disrupted by high temperatures.

The influence of the position of the depth of coal on the resulting in place gas content can be seen in Figure 2. The curve shows a comparison between the position of the depth of coal with gas in place from the coal methane gas produced. The sample data used is the data of the five wells sampled, namely wells: MUT127, MUT128, 129, 130, and 131.



**Figure 2.** Curve effect of the position of the depth of coal on the gas content generated in place

Based on the curve above the large in place gas content is found at depths between 750 and 1000 m. This is due to the depth of the coal absorption capacity has not been disturbed by high temperatures and methane gas is not easily separated from the coal layer so that it can be stored in coal properly (Joko and Dati, 2012). This is also evidenced by the initial exploration results of SKK Migas together with PT Virgina Indonesia Co. that for the Kutai Basin the best position for coal methane gas production is between 750 and 1000 meters.

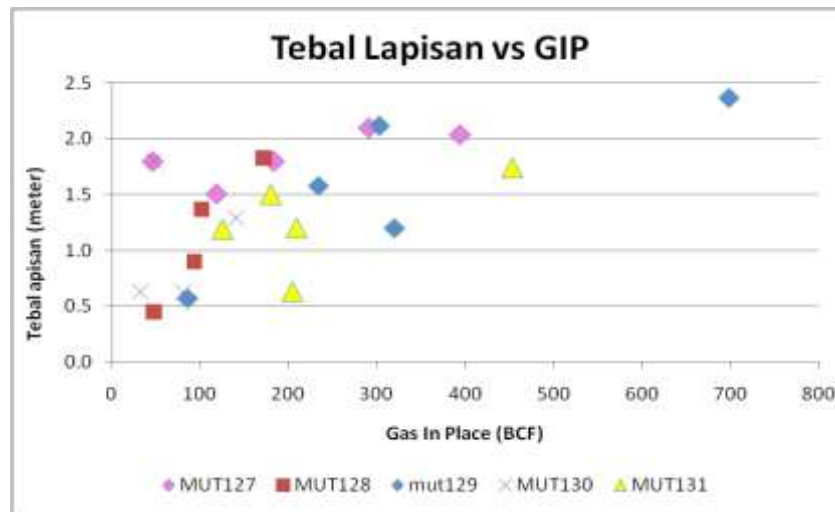
Based on the above curve also the highest in place gas content is contained in the MUT129D well sample located at a depth of 769.5 meters with an in place gas content of 698.2555 bcf. The lowest in place gas content was found in the MUT130D well sample, amounting to 31.7038 bcf, located at a depth of 1229.1 meters. One of the causes of the low gas content in place in the MUT130D well sample is a position that has reached a depth of 1229.1 meters where at that position the capacity of coal is disrupted by high temperatures.

### 3.3. The effect of the thickness of the coal seam on the value of the gas in place produced

The thickness of the coal seam influences the amount of methane gas. After obtaining the required data, the selection of the coal seam can be made in accordance with the specified provisions.

That is because coal seams at a greater thickness will increase the value of the gas in place. Coal seams which have a thickness below 1 m are considered to have no potential for the development of coal methane gas, whereas coal seams with thicknesses above 1 m, have great potential, especially if coal thickness increases. Coal seams with a thickness of less than 1 m are considered to be uneconomic, because the coal methane gas content adsorbed on the coal layer has less potential.

The thicker coal layers increase the adsorbed gas content the greater. The thicker coal layer causes the gas in place to be greater. A large in place gas increases the economics of coal methane gas. The economics of methane gas can be seen from the large gas content in place contained in one layer of coal. The influence of the thickness of the coal layer on the resulting in place gas content can be seen in Figure 3.



**Figure 3.** Curve effect of coal thickness on the resulting in place gas content

Based on the curve above the thicker the coal layer, the higher the gas content in place produced. This is due to the thicker coal layer, the adsorbed methane gas content will be even greater.

Based on the curve above, the highest gas content in place is found in the MUT129D sample, which is 698.2555 bcf, this is caused by the ideal inward position and the thickness of the layer which reaches 2.12 meters (the highest among other well samples). For the lowest in place gas content in the MUT130D well sample of 31,708 bcf, this is due to the position of the coal which is too deep and also the thickness of the layer that is less than 1 meter (0.63 meters) so that the absorption of coal methane gas is very small.

#### 4. Conclusion

1. The total content of the five well samples are as follows: MUT 127 1031.4524 bcf, MUT 128 411.7179 bcf, MUT 129 1640.1579 bcf, MUT 130 299.5515 bcf, and MUT 131 1171.5445 bcf.
2. The deeper the position of the coal, the greater the gas content in place with a maximum depth of 1000 meters. At 129th D-MUT, the highest gas content in place was 698.2555 bcf at depth position 769.5 meters.
3. The thicker the coal layer, the greater the gas content in place. At the 129th D MUT, the highest gas content in place was 698.2555 bcf with coal thickness of 79 ft.

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