Determination of Methane Content at Hongthai Coal Mine from Curent Mining To -150 Level in Vietnam

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Abstract: Methane gas is one of the most serious dangers of underground coal mining as its buildup can lead to methane gas explosion. In Quang Ninh province- Vietnam, several coal mines such as MạoKhe coal mine, Khe Cham coal mine,… especially Hong Thai mine that have high methane content. At the Hong Thai coal mine, experimental data showed that the concentration of methane in coal seams at different depths were not similar. In order to ensure safety, this report has been undertaken to determine a pattern of changing methane contents of coal seams at different exploitation depths in Hong Thai underground coal mine.
Keywords: methane hazard, HongThai coal mine,methane content.

1. INTRODUCTION TO HONGTHAI COAL MINE [1,3]

HongThai coal mine is located in HongThai commune, DongTrieu town, Quang Ninh province, Vietnam

+ The North, it borders on TrangLuong commune

+ The East, it borders Trang Bach East coal mine

+ The South, it borders on TrangBach South coal mine

+ The West, it borders with MaoKhe coal mine

Geographical coordinates of HongThai coal mine:

From 23º 00'42" to 23º 08'42" North latitude

From 105º 13'35" to 105º17'47" East longitude

The expected output of HongThai coal mine in 2018 is 700 000 tons/year.

At the moment, HongThai coal mine is mining at level +30 and this mine is digging tunnel lying tilt from level +30 to level -150.

It is therefore necessary to determine the methane content of the coal seams from level +30 to level -150 of HongThai coal mine

2. COAL SAMPLING AND METHANE GAS ANALYSIS SEQUENCE

Take the coal sample from boreholes drilled into the coal seams at a depth of 4.5 m and put into steel containers, with tightly covered lid.

Samples of coal are fed into a vibrating shaker inMine safety center- Vinacomin's laboratory to crush the sample by the impact of steel balls. Then introduced into the vacuum gas separation system to separate the gas and determine the volume of gas (Fig 1). The extracted gas composition was analyzed by VARIAN gas chromatography. Analysis results from the VARIAN machine will determine the volume of methane gas from each sample of coal (Analysis results are presented in Section 3)
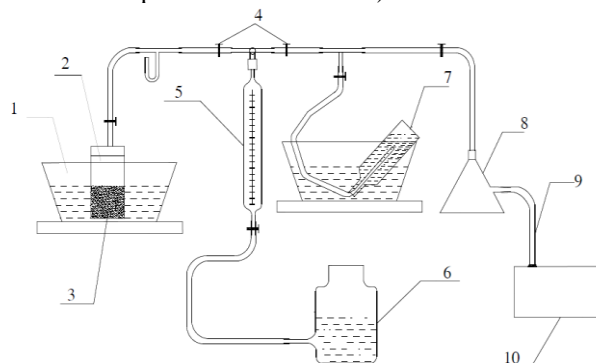

Fig.1. Gas separation diagram by vacuum heat

1. Hot water bottle; 2.Coal sample container; 3.Electric stove; 4.Regulating valve; 5. Piet measured the volume; 6. Pressure vessel; 7.Bottle containing specimen separation gas; 8. Intermediate gas cylinders; 9. Tube; 10.Vacuum machine

From the results of the analysis, establish a relationship between the trend of methane density and the depth of the coal seam by using Excel software to construct methane gas prediction graph (the least squares method). Forecast results are presented in Section 4.

3. RESULTS OF ANALYSIS OF METHANE CONTENT IN HONGTHAI COAL MINE [2]

The results of the analysis are shown in table 1 to table 8 with the corresponding coal seams.

Tab1.Analysis results CH_4 at N^09b coal seam

TT	Depths	CH_4 density, m^3/T_{KC}
1	+90	0.16
2	+60	0.198
3	+30	0.2305

Tab2.Analysis results CH_4 at N^045 coal seam

TT	*Depth*	*CH_4 density, m^3/T_{KC}*
1	+251	0.00731
2	+175	0.16933
3	+125	1.395

Tab3.Analysis results CH_4 at N^012 coal seam

TT	*Depth*	*CH_4 density, m^3/T_{KC}*
1	+350	0.00445
2	+115	0.21959
3	+30	0.2472

Tab4.Analysis results CH_4 at N^018 coal seam

TT	*Depth*	*CH_4 density, m^3/T_{KC}*
1	+126	0.208
2	+90	0.523
3	+75	0.61022
4	+30	0.634

Tab5.Analysis results CH_4 at N^043 coal seam

TT	*Depth*	*ĐCKdensity, m^3/T_{KC}*
1	+190	0.5
2	+125	0.611
3	+75	1.007
4	+30	2.0611

Tab6.Analysis results CH_4 at N^046 coal seam

TT	*Depth*	*CH_4 density, m^3/T_{KC}*
1	+180	0.09173
2	+155	0.218
3	+85	1.01906
4	+30	1.07221

Tab7.Analysis results CH_4 at N^010 coal seam

TT	*Depth*	*CH_4 density, m^3/T_{KC}*
1	+280	0.008918
2	+140	0.01
3	+115	0.022
4	+110	0.02775
5	+100	0.0342
6	+95	0.05776

Tab8.Analysis results CH_4 at N^024 coal seam

TT	Depth	CH_4 density,m^3/T_{KC}
1	+125	0.138
2	+120	0.127036
3	+75	0.14243
4	+50	0.151
5	+30	0.15301
6	+4	0.177

4. RESULTS OF GAS DENSITY FORECAST METHANE AS MINE CONTINUE TO EXPLOIT DEEPER

From the methane content figures in tables 1 to tables 8, We use Excel software to graph the gas variability at different levels of coal seams.

The results of the analysis are shown in table 9 to table 16, and Fig 2 to Figure 9 with the corresponding coal seams
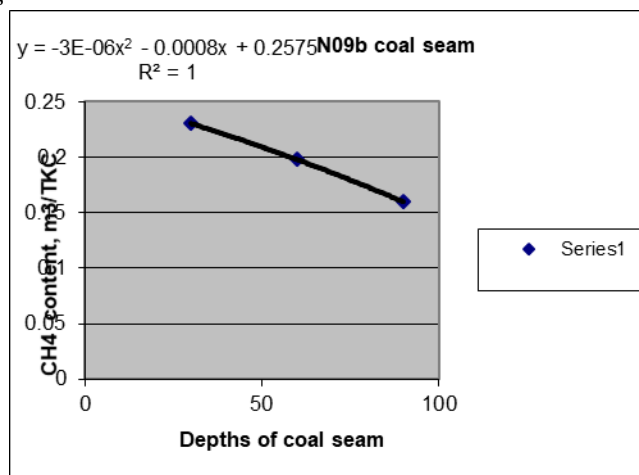

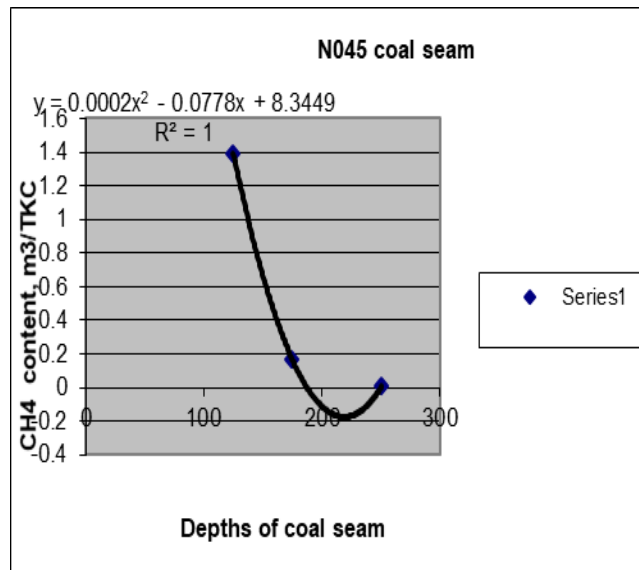Fig.2. Forecast chart CH_4 at N^09b coal seam
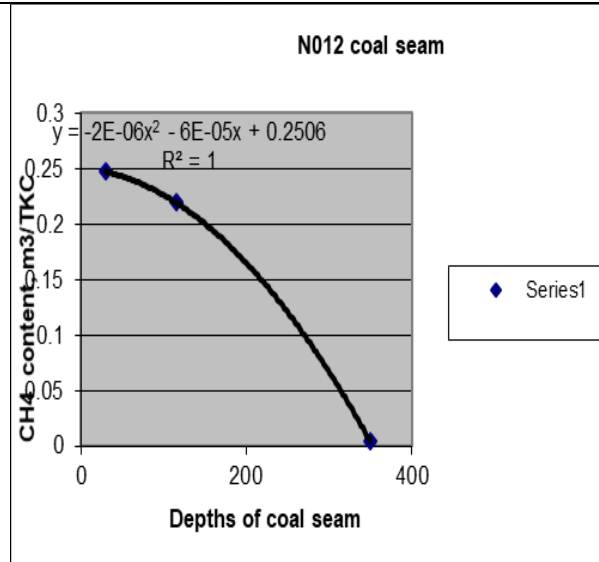

Fig.3. Forecast chart CH_4 at N^045 coal seam

Fig.4. Forecast chart CH_4 at $N^0 12$ coal seam
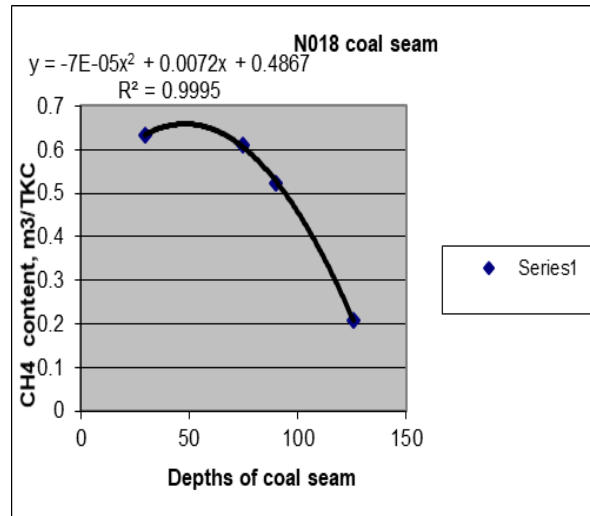
Fig.5. Forecast chart CH_4 at $N^0 18$ coal seam
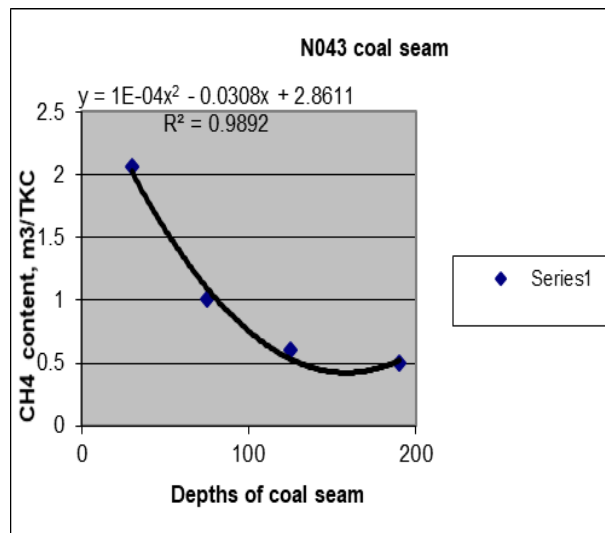
Fig.6. Forecast chart CH_4 at $N^0 43$ coal seam

N046 coal seam

$y = -5E-05x^2 + 0.0026x + 1.0633$
$R^2 = 0.966$
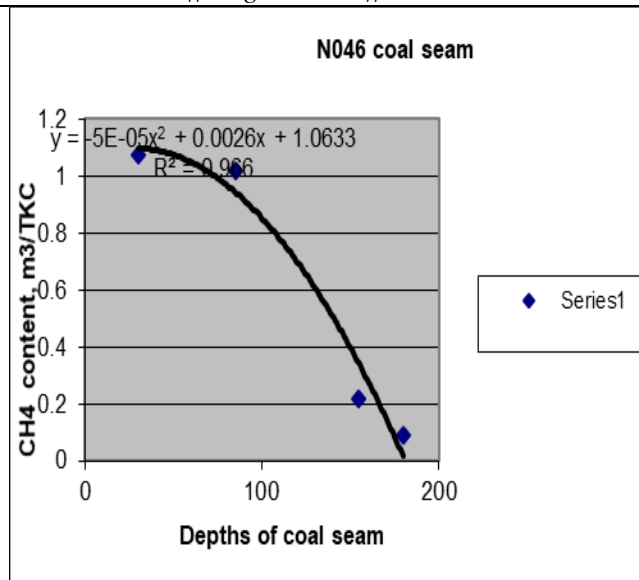
Fig.7. Forecast chart CH_4 at N^046 coal seam

$y = 5E-06x^2 - 0.0021x + 0.2044$ **N010 coal seam**
$R^2 = 0.8702$
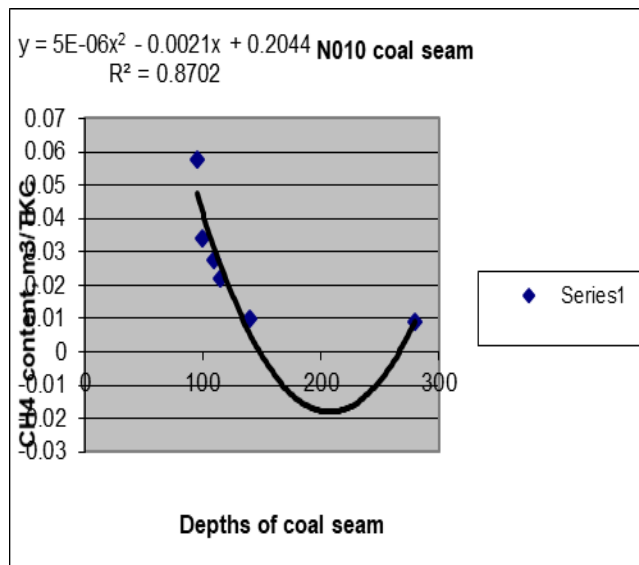
Fig.8. Forecast chart CH_4 at N^010 coal seam

$y = 3E-06x^2 - 0.0007x + 0.1778$
$R^2 = 0.9253$ **N024 coal seam**
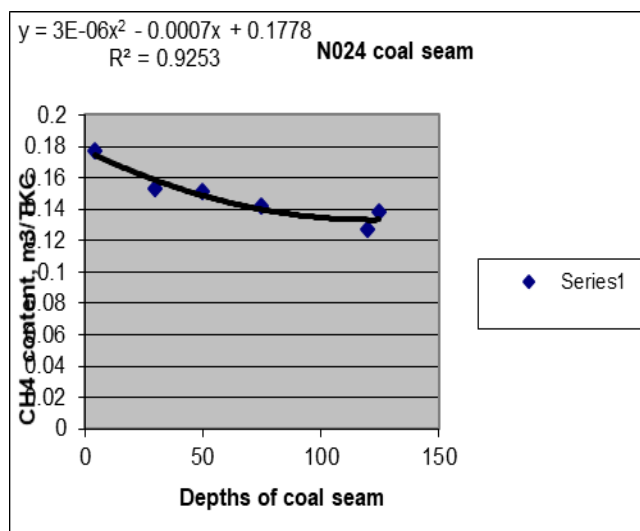
Fig.9. Forecast chart CH_4 at N^024 coal seam

Tab 9.Forecast results CH_4 at N^09b coal seam

TT	Depth	CH₄ density, m³/Tкс
1	0	0.2627
2	-50	0.3227
3	-100	0.3827
4	-150	0.4427

Tab10.Forecast results CH_4 at N^045 coal seam

TT	Depth	CH₄ density, m³/Tкс
1	+50	1.8982
2	0	2.4132
3	-50	2.9282
4	-100	3.4432
5	-150	3.9582

Tab11.Forecast results CH_4 at N^012 coal seam

TT	Depth	CH₄ density, m³/Tкс
1	-125	0.715
2	-150	0.9358

Tab12.Forecast results CH_4 at N^018 coal seam

TT	Depth	CH₄ density, m³/Tкс
1	0	0.8399
2	-50	1.0549
3	-100	1.2699
4	-150	1.4849

Tab13.Forecast results CH_4 at N^043 coal seam

TT	Depth	CH₄ density, m³/Tкс
1	0	2.15
2	-50	2.47
3	-100	2.93
4	-150	3.39

Tab14.Forecast results CH_4 at N^046 coal seam

TT	Depth	CH₄ density, m³/Tкс
1	0	1.4164
2	-50	1.7814
3	-100	2.1464
4	-150	2.4511

Tab15.Forecast results CH_4 at N^010 coal seam

TT	Depth	CH₄ density, m³/Tкс
1	+50	0.1009
2	0	0.2044
3	-50	0.3109
4	-100	0.4204
5	-150	0.5329

Tab16.Forecast results CH_4 at N^024 coal seam

TT	Depth	CH₄ density, m³/Tкс
1	-50	0.1846
2	-100	0.1996
3	-150	0.2146

5. CONCLUSION

From the results of the analysis and forecast results from table 1 to tables 8 and figures 1 to figures 8 show the degree of methane storage in the coal seams of the mines with great variation. And the greater the depth, the higher the gas density. Specific for each seam as follows:

- For N^09b coal seam: From depths level +90 to depths level -150 the density of methane contained in the coal seam is determined and predicted from 0.16 m^3/T_{KC} to 0.4427m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam)[4] .

- For N^045 coal seam: From depths level +251 to depths level 0 the density of methane contained in the coal seam is determined and forecasted from 0.0731m^3/T_{KC} to 2.4132m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam). At depths below level 0 to level -150 the methane content forecasted from 2.5 m^3/T_{KC} to 3.9582m^3/T_{KC} (This coal seam is ranked II according to QCVN / 03-BCT / 2011, Vietnam) [4]

- For N^012 coal seam: From depths level +350 to depths level -150 the density of methane contained in the coal seam is determined and forecasted from 0.00445m^3/T_{KC} to 0.9358m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam) [4]

- For N^018 coal seam: From depths level +126 to depths level -150 the density of methane contained in the coal seam is determined and forecasted from 0.208m^3/T_{KC} to 1.4849m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam) [4]

- For N^043 coal seam: From depths level +190 to depths level -50 the density of methane contained in the coal seam is determined and forecasted from 0.5m^3/T_{KC} to 3.4096m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam). From depths level -60 to depths -150, the density of methane contained in the coal seam is forecasted from 2.5m^3/T_{KC} to 3.39m^3/T_{KC} (This coal seam is ranked II according to QCVN / 03-BCT / 2011, Vietnam) [4].

- For N^046 coal seam: From depths level +180 to depths level -150 the density of methane contained in the coal seam is determined and forecasted from 0.09173m^3/T_{KC} to 2.4511m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam). [4]

- For N^010 coal seam: From depths level +280 to depths level -150 the density of methane contained in the coal seam is determined and forecasted from 0.008918m^3/T_{KC} to 0.5329m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam[4]).

- For N^024 coal seam: From depths level +125 to depths level -150 the density of methane contained in the coal seam is determined and forecasted from 0.138m^3/T_{KC} to 0.2146m^3/T_{KC} (This coal seam is ranked I according to QCVN / 03-BCT / 2011, Vietnam[4]).

From the results of sampling analysis and use the least squares method of the Excel software to forecast. The results of the analysis are shown in table 9 to table 16. As a result of this prediction, HongThai coal mine has plans to eliminate the danger of methane gas to ensure the safety of mining.

On the other hand, when the mine moves to ranks II, HongThai coal mine will have to plan to open the coal seam, prepare, exploit, and select the appropriate equipment.

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