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One-Day Prognoses of Methane Concentrations for the 102 Longwall in the 325/1 Seam in the "W" Coal Mine Operating in a Continuous System

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INTRODUCTION

Approximately 80% of output in the Polish coal mining industry comes from methane bearing beds. In some mines, during the longwall exploitation, the total amount of methane released to the ventilation air and captured by the methane removal system exceeds 100 m^3/min. The methane must be captured by a methane removal system, an adequate amount of air must be supplied to ensure safe working conditions. Correct ventilation schemes must be applied, and auxiliary ventilation measures must be used. Because the coal deposits are multi-seam and include coal seams that are not fit for exploitation, methane reaches the workings from the exploited seam, the over and under-laying seams as well as from rock seams which are characterized by high porosity, that is, e.g., sandstones and conglomerates. The methane content in the rock mass is not uniform.

The amount of the released methane is dependent on the current location of the longwall, the intensity of the exploitation and the variations of the atmospheric pressure. The problems related to the presence of methane in coal deposits are still relevant. This is exemplified by numerous publications (Bibler C.J., et al., Karacan C. Ö., 2008, Karacan C. Ö., 2009, Karacan C. Ö., et al.,2008 2011, Lunarzewski, L.W., 1998, Mishra D., et al., Niewiadomski A.P., Badura H., 2019, Noack K., 1998, Shi L., et al., Ślęzak D., et al., The US EPA, 2009, Zawadzki J., et al.,).

These publications concern the prevention of methane hazard, prognoses of methane release to workings, capturing methane using drainage holes and using methane as a source of energy.

This article concerns the prognosis of methane concentration in the area of an exploited longwall. Most of all, this may ensure a higher working safety level by allowing the selection of proper methane prevention measures as well as it may

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serve as a basis for deciding to use the methane from the ventilation air as an energy source.

CHARACTERISTICS OF NATURAL CONDITIONS IN THE 102 LONGWALL EXPLOITATION PANEL IN THE 325/1 SEAM AS WELL AS THE TECHNICAL PARAMETERS OF THE LONGWALL

In the area of the 102 longwall panel, the 325/1 seam contained a large number of impurities in the form of clay slate and coal slate inserts. The thickness of the seam at the initial section of the longwall panel was approximately 2.50 m (including approx. 0.25 m of barren rock), while in the final section it was approximately 3.00 m (including around 0.40 m of barren rock). The seam, at the area of nearly the entire exploitation panel, was comprised of two coal layers, while the thickness of the lower layer varied from 0.60 to 1.40 m and the top layer varied from 1.00 to 1.40 m.

Due to the upper limit of safe operation of the applied longwall supports, that is 2.75 m, a coal layer was left in the floor with a thickness of 0.25 in the final area of the longwall's run.

A total of 19 exploratory boreholes were made within the longwall to conduct penetrometer tests and to identify the roof layers, including 16 boreholes in the top-gate No. 2 and 3 boreholes in the bottom-gate No. 3.

In the direct roof of the seam, a layer of unconsolidated clay slates was found with a thickness from 0.15 to 0.20 m. Subsequently, a layer of coal with slates was found with a thickness from 0.15 to 0.20 m. The presence of these layers caused the geomechanical parameters of the roof to decrease, which in turn caused problems with the support of the roof of the longwall.

Above these layers – in the roof of the 325/1 seam, a mudstone layer was found with a thickness from 2.5 m to 6.3 m and very low strength. In the area of the 102 longwall raise and sections of the 2 and 3 gates near the raise, this layer became fully thinned-out, and sandstone took its place in the roof directly above the seam. Sandstone was found above the layer of mudstone, with a thickness from 2.5 to 18.0 m, in some areas divided by a 2-meter layer of clay slate. Above the sandstone, there was a layer of mudstone with a thickness from 3.00 to 5.00 m, above which there was the 324 seam with a thickness of 1.0 m. A layer of mudstone with a thickness of 1.0 m was found directly above the 324 seam, and a 10 m layer of sandstone, clay slate with a thickness of 1.0 m and a 2-metre thick 323 seam followed. Above this seam, a mudstone layer with a thickness of 0.5 m was found, followed by an unnamed coal seam with a thickness of 0.4 m. Subsequently, there was a mudstone layer with a thickness of 4.4 m followed by the seam 321 with a thickness of 1.2 m. Mudstone was found above that seam.

A total of 4 exploratory boreholes were made in the area of the longwall to identify the thickness and the properties of floor rocks, including 2 boreholes in the top-gate No. 2 and 1 borehole in the bottom-gate No. 3.

In the floor of the 325/1 seam, there was a layer of mudstones with a thickness from 10.0 to 11.0 m with high upthrust susceptibility, followed by the 325/2 seam in the form of coal slated with a thickness of approx. 1.4 m. Below that seam, mudstones and clay slates were found with a thickness of 8.0 m, followed by the 327 seam with interburdens of coal and clay slates and a gross thickness of 3.10 m.

No exploitation edges of lower seams were found in the 102 longwall area.

Above the 102 longwall panel, exploitation edges of the 212/2, 214/1-2, 304, 308, 312 and 315 occurred. The goafs and the edges of the 212/2, 214/1-2, 304 and 308 seams were found at a vertical distance exceeding 160 m. The exploitation edges in the 312 seam were found at a distance from 153 to 161 m, while in case of the 315 seam, the distances were from 112 to 118 m.

The 102 longwall in the 325/1 seam was characterized by:

- Length from 240 m to 250 m,
- Panel length of 1544 m,
- Height of 2.75 m,
- Longitudinal inclination from 10° to 15°,
- Lateral inclination from 2° to 3°,

The exploitation of the 325/1 seam using the 102 longwalls was commenced on 16.02.2015 and completed on 13.02.2016. The exploitation was continuous, for 7 days a week.

VENTILATION OF THE LONGWALL 102 AREA AND METHANE PREVENTION

Ventilation of the area of the longwall 102 may be divided into two periods. In the first period, lasting from 16.02.2015 to 16.08.2015, a U-ventilation system was used in the longwall area (Fig. 1).

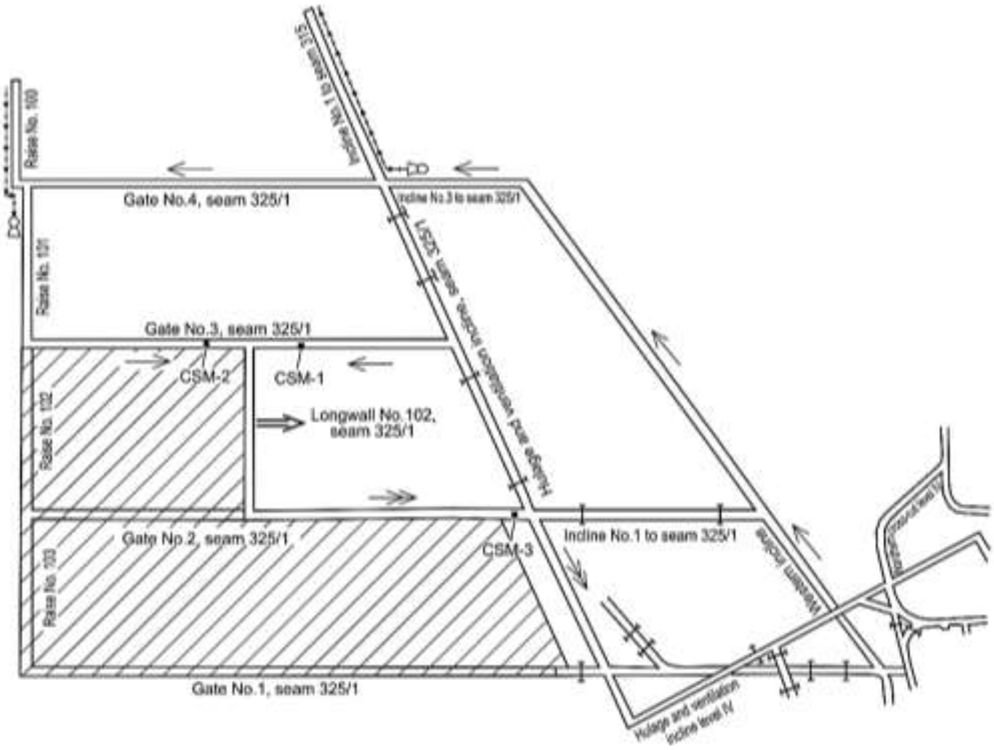

Fig. 1 The ventilation pattern of the longwall region 102 in the first period of operation by a longwall

The air was supplied from the downcast shaft using the western drift to the drift No. 3 to the 325/1 seam and subsequently it was delivered using a ventilation and haulage drift to the gate No. 3 in the seam 325/1 and to the longwall 102. A section of the gate No. 3 between the current position of the longwall and the former raise of 102 was ventilated using a separate system. The gate No. 3 was maintained due to the planned exploitation of a part of the 325/1 seam using the 101 longwall below the 102 panel.

After ventilating the 102 longwalls, the used air was removed using gate No. 2 to the haulage and ventilation drift in the 325/1 seam and further – using the haulage and ventilation drift No. IV to the upcast shaft.

In the period of concern from 1200 m^3/min to 1450 m^3/min of air was being supplied to the longwall.

In the second period of exploitation, from the time of connection of the raise No. 101 with the gate No. 3, that is from 17.08.2015, until the end of exploitation, a Y-ventilation system was applied (Fig. 2).

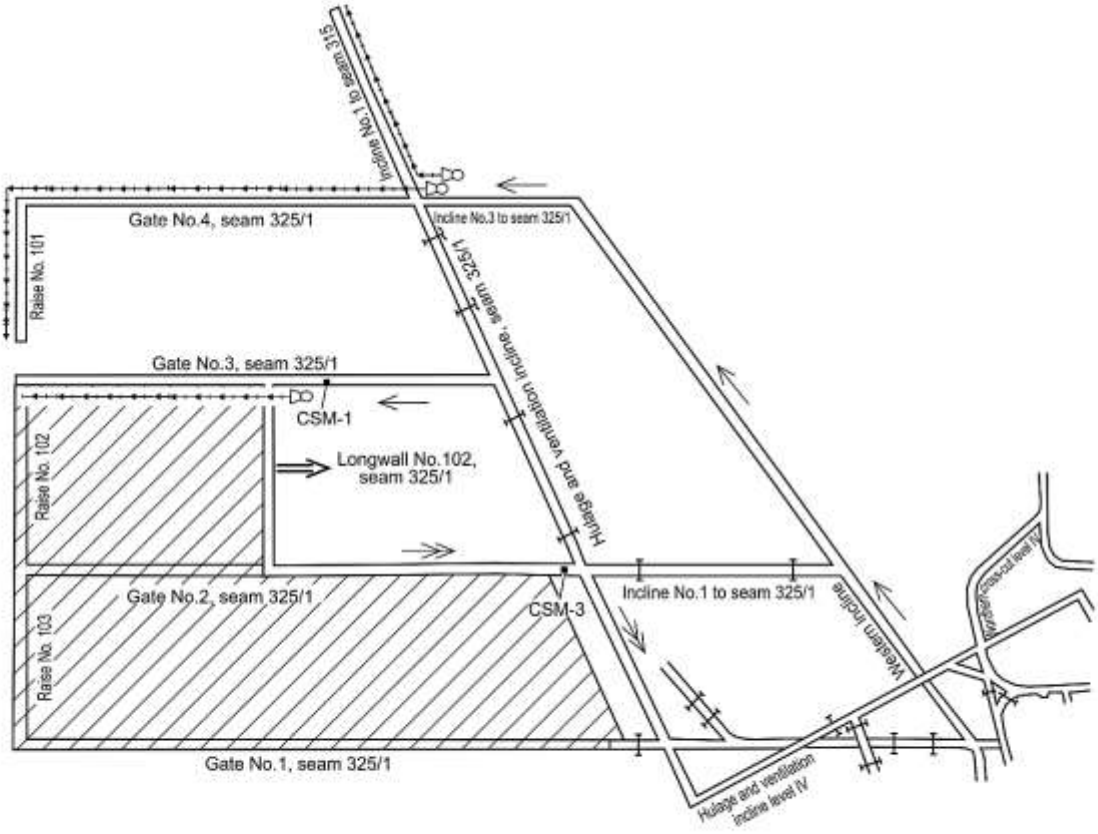

Fig. 2 The scheme of ventilation of the longwall region 102 in the second period of the longwall's operation

Fresh air was delivered from the shaft bottom of the downcast shaft through the western drift to the drift No. 3 to the 325/1 seam. At the intersection of the drift No. 3 to the 325/1 with the haulage and ventilation drift in the seam 325/1; the air was divided into two streams. The first stream was flowing through the haulage and ventilation drift to the gate No. 3 in the 325/1 seam and continued to the mouth of the longwall. The second stream was flowing through gate

No. 4 in the seam 325/1, through the raise of the 101 longwalls in the 325/1 seam and further along the goafs of the longwall 102, through gate No. 3 to the mouth of the longwall 102, where it joined the stream of air flowing from the eastern side of the gate No. 3. The mixed streams of air were used for ventilating the longwall.

The used air from the longwall was flowing through gate No. 2 in the seam 325/1 to the haulage and ventilation drift in the seam 325/1 and further using the haulage and ventilation drift No. IV to the bottom of the upcast shaft.

In the period of concern, the volumetric flow of fresh air supplied to the longwall was 1500 m^3/min. In the period from 17.08.2015 to 30.11.2015, the volumetric flow of the air from the eastern side, flowing through the gate No. 3 was 900 m^3/min, while the flow from the western side was 600 m^3/min. In the period from 01.12.2015 to 13.02.2016 (until the end of exploitation using the longwall 102), the values of the air stream changed into 1050 m^3/min and 450 m^3/min, respectively.

CHARACTERISTICS AND PREVENTION OF METHANE HAZARD

A methane removal system was applied to prevent excessive release of methane to the workings of the longwall 102 area, Drainage holes were performed before the longwall, from the gate No. 2 over the unmined exploitation panel of the longwall 102 towards the longwall.

To limit the release of methane to the gate No. 2 from the goafs of the longwall 103, present in the vicinity of the gate (on the south), methane removal from the goafs was applied. The goafs of the longwall 103 joined the workings of the longwall 102 area, which served for the outtake of used air from the 102 longwalls.

A large inflow of methane at the path of the air flowing to the longwall was a characteristic feature of the ongwall102 l in the 325/1 seam (Fig. 3).

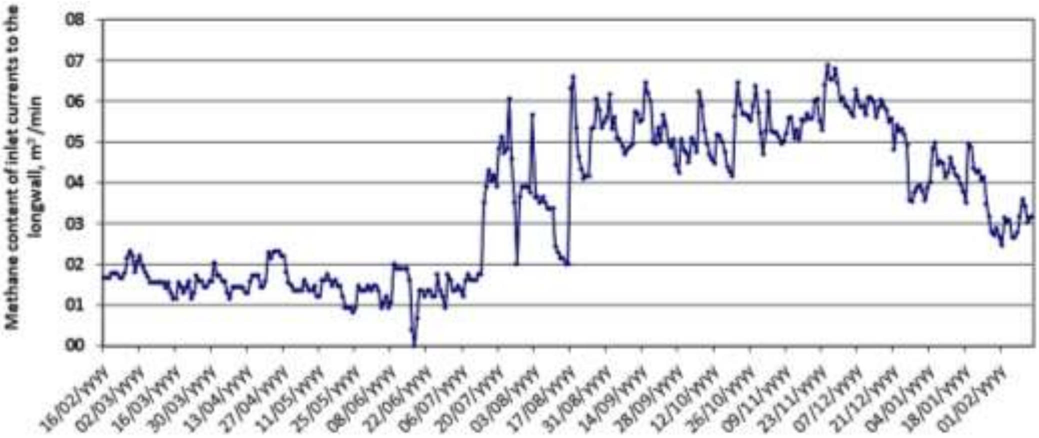

Fig. 3 Methane of air entering the longwall 102

In the U-ventilation period, the volume of methane flowing into the longwall was calculated based on the measurement of methane concentration using a CSM-1 sensor (Fig. 1), while in the Y-ventilation period, based on the indications of the CSM-1 and CSM-2 sensors (Fig. 2)

In the exploitation period from 16.02.2015 to 13.07.2016, the methane content in the supplied air was usually within a range of approx. 1 m^3/min to approx. 2 m^3/min. After that period, there was a sudden increase, characterized by large variations. The lowest value then reached 2.0 m^3/min, while the highest was 6.9 m^3/min.

The ventilation methane content for the longwall 102, determined based on the concentration measurements using the CSM-3 sensor, without consideration given to the methane flowing to the fresh air, was maintained within the range from 1.56 m^3/min to 16.68 m^3/min and the mean value was 9.81 m^3/min.

Figure 4 presents the ventilation methane content for the longwall 102 without consideration given to the inflow of methane to fresh air before the mouth of the longwall.

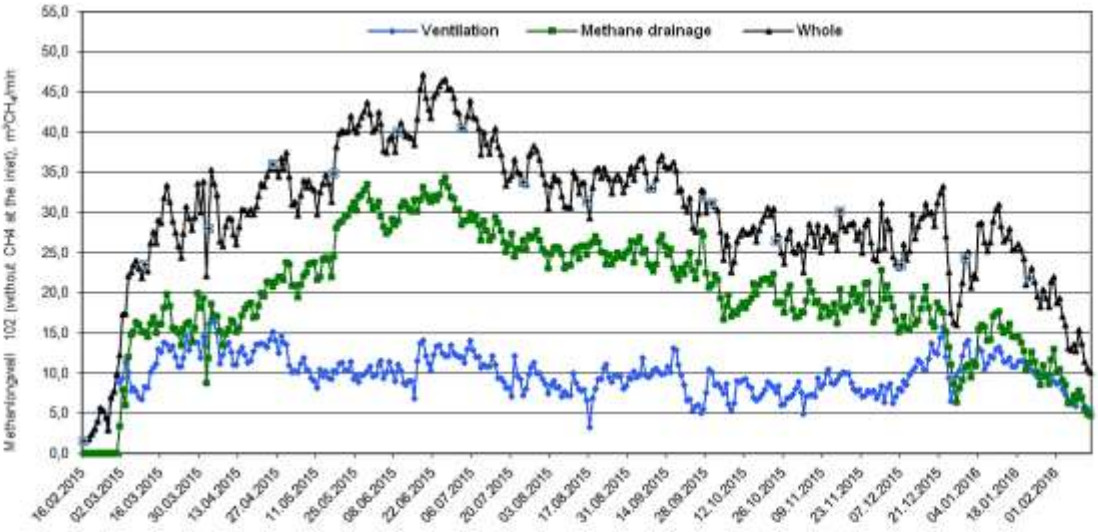

Fig. 4 Methane longwall 102 without taking into account the flow rate of methane at the inlet to the longwall

The ventilation methane content was within the range from 1.6 m^3 CH$_4$/min to 16.7 m^3 CH$_4$/min, and its mean value was 9.8 m^3 CH$_4$/min.

Methane removal from the area of the longwall 102, using drainage holes over the exploitation panel of the longwall 102, was commenced on 01.03.2015.

The volumetric flow of methane captured by the methane removal system (from 01.03.2015) varied in the range from 3.4 m^3/min to 34.4 m^3/min, and its mean value was 20.7 m^3/min.

The total methane content in case of the longwall 102 (without the methane flowing in the stream of air supplied to the longwall) was in the range from 1.6 m^3/min to 47.2 m^3/min. The mean value of the total methane content for the longwall 102 was 29.8 m^3/min.

Figure 5 presents the methane content in the area of the longwall 102 while giving consideration to the methane flowing with the fresh air, The methane released from the longwall and the workings used for the outake of used air as well as the methane captured during the current-basis methane removal from the 102 longwall and the goafs of the 103 longwall.

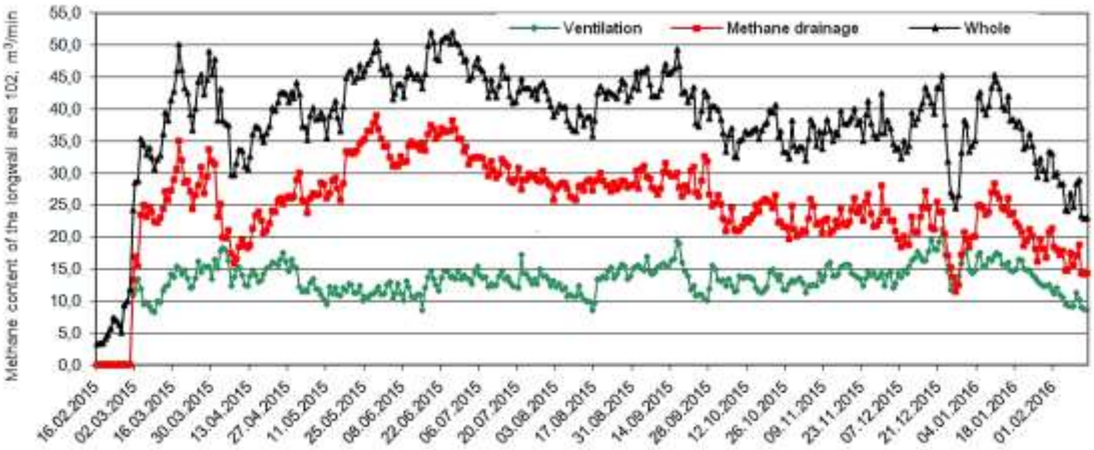

Fig. 5 The methane content of the longwall area 102, including all methane sources

The ventilation methane content was within the range from 3.24 m^3/min to 21.15 m^3/min, and its mean value was 13.25 m^3 CH_4/min. The methane removal system captured from 11.40 m^3/min up to 38.9 m^3/min of methane (current-basis methane removal from the longwall 102 and methane removal from the goafs of the longwall 103), with a mean value of 11.4 m^3 CH_4/min. The total methane content was within the range from 3.24 m^3/min up to 52.12 m^3/min, and the mean value was 38.3 m^3 CH_4/min.

At the intersection of the longwall 102 with the No. 2 (ventilation) gate, auxiliary ventilation measures were applied including a ventilation dam with an airlock as well as air jet pumps. The 102 gallery was liquidated along with the advance of the longwall 102.

An important role in methane prevention is played by the system for controlling the physical and chemical properties of the mine’s atmosphere. 16 methane concentration sensors were installed in the area of the longwall 102 along with 3 stationary anemometers, a sensor for the operation of the ventilation pipe fan, an anemometer for measuring the difference of pressures at the dams of the airlock (to determine the tightness of the dams) and 2 sensors of opening of the ventilation dams.

Besides the automatic measurements, manual measurements of methane concentration in the workings were performed and documented.

RESEARCH METHOD

The problem of current short-term prognoses of methane content or methane concentration, including one-day prognoses, has been considered in several works (Badura H., 2004, Badura H., Jakubów A., 2007, Badura H., 2013, Badura H. et al., 2015,Badura H., Szczęsny K., 2016).

These studies concerned longwalls operating in a 5-day or a 6-day system or an irregular exploitation system using longwalls. The 102 longwall in the 325/1 seam in the “W” coal mine was exploited continuously for 7 days a week and any interruptions only concerned statutory holidays.

In work Badura, 2013, based on the measurement data from 10 longwalls located in coal mines of the Jastrzębska Spółka Węglowa S.A., prognostic models were developed to achieve a one-day prognosis of methane concentration at the exhaust from the area of the longwall exploited for 5 days a week – from Monday to Friday. The prognostic models are linear equations in the following form:

$$y = a_0+a_1x$$

where:

y – predicted methane concentration on a given day of the week,

x – measuring methane concentration on the previous day,

a_0, a_1 – prognostic model parameters for given days of the week.

The values of the parameters of the a_0 and a_1 models have been presented in table 1. In the table, the R^2 and r factors denote the coefficient of determination and correlation, respectively, calculated for each of the prognostic models.

Table 1 Linear equations parameters, exhibiting the relation between the mean daily methane concentration on a given day of the week and the mean daily methane concentration on a previous day

Day		Parametr a_0	Parametr a_1	Factor		Error parameter a_0	Error parameter a_1
Considered	**Previous**			R^2	r		
Monday	Sunday	0,2536	0,7241	0,47	0,69	0,05037	0,02950
Tuesday	Monday	0,1256	0,9623	0,71	0,84	0,03906	0,02603
Wednesday	Tuesday	0,1027	0,9014	0,80	0,89	0,02915	0,02294
Thursday	Wednesday	0,0468	0,9405	0,88	0,94	0,02193	0,01787
Friday	Thursday	0,0458	0,9459	0,83	0,91	0,02709	0,02208
Saturday	Friday	0,0869	0,7213	0,67	0,82	0,03231	0,02653
Sunday	Saturday	0,0534	0,7667	0,75	0,87	0,02811	0,01930
Monday	Saturday	0,1723	0,7373	0,62	0,79	0,03743	0,02579

While using these models, 1800 one-day prognoses of mean methane concentration were conducted. Most of the prognoses were conducted for longwalls operating for 5 days a week. While modifying the method of providing a prognosis for a 5-day week, prognoses for a longwall exploited irregularly were also conducted – as well as prognoses for a longwall exploited for 6 days in a week. In both cases, prognostic models for five days of exploitation in a week were applied while changing the method of application. In case of prognoses developed for all the longwalls, the absolute error that did not exceed 0.1% of the methane concentration constituted from 78% to 86% of all absolute errors of the prognoses. While the absolute errors with a value not exceeding 0.15% of the methane concentration constituted from 92% to 95% of all errors.

In the described case of continuous exploitation for 7 days a week, the prognostic equations developed in Badura, 2013 were also used for the prognosis of the mean methane concentration, while:

- in the first five days of exploitation, the prognostic models for days from Monday to Friday were used,
- for other days, only the prognostic model for Friday was used,
- in case of a one-day interruption, the prognostic model for Saturday was applied (5 cases), on the next, first working day, a model for Monday was used, depending on the methane concentration on Saturday and then the model developed for Friday was used,
- In case of a two-day interruption (one case), the prognostic model for Saturday was used on the first day, and a model for Sunday was used for the second day. On subsequent five days of exploitation, prognostic models applicable for days from Monday to Friday were used, and subsequently, only the model for Friday was applied.

RESULTS OF THE STUDY

Figure 6 presents charts of values of the mean methane concentration at the exhaust of the gate No. 2 obtained using measurements and prognoses. The anticipated values of the mean methane concentration have been marked as prognosis 1. The mean concentration of methane (measured and resulting from prognosis) does not provide for the methane in the air flowing into the longwall.

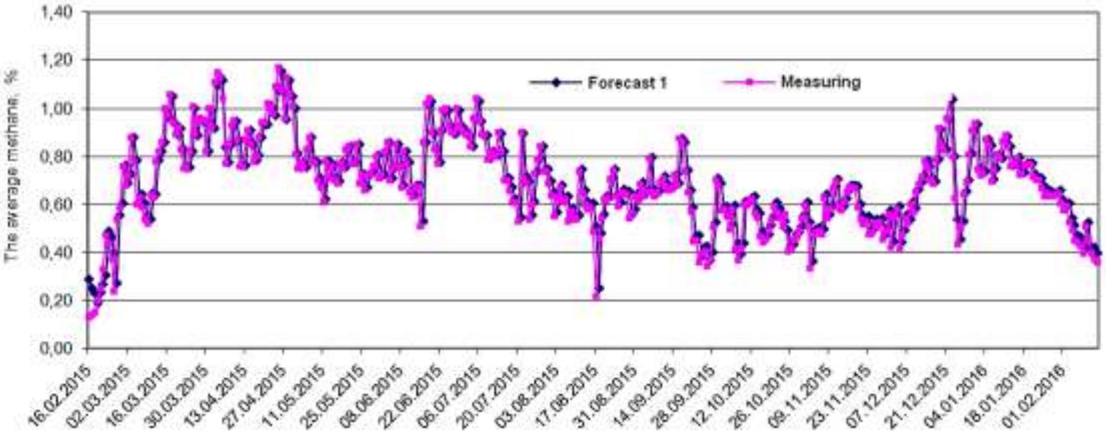

Fig. 6 The average methane concentration measured and forecasted at the outlet from the longwall region 102 without taking into account methane in the fresh air current

The accuracy of the prognosis may be estimated based on the chart presenting the correlation between the measured and anticipated mean concentrations (Fig. 7).

The values of the slope of the straight line and the coefficient of determination for a perfect prognosis should be 1. In the dependence shown in Figure 6, the slope coefficient is 0.9989, differing from 1 only by 0.0011. The value of the determination coefficient is $R^2 = 0.7633$, and thus the correlation coefficient is $r = 0.87$. It may thus be said that the correlation between the predicted and the measured mean concentration of methane is high.

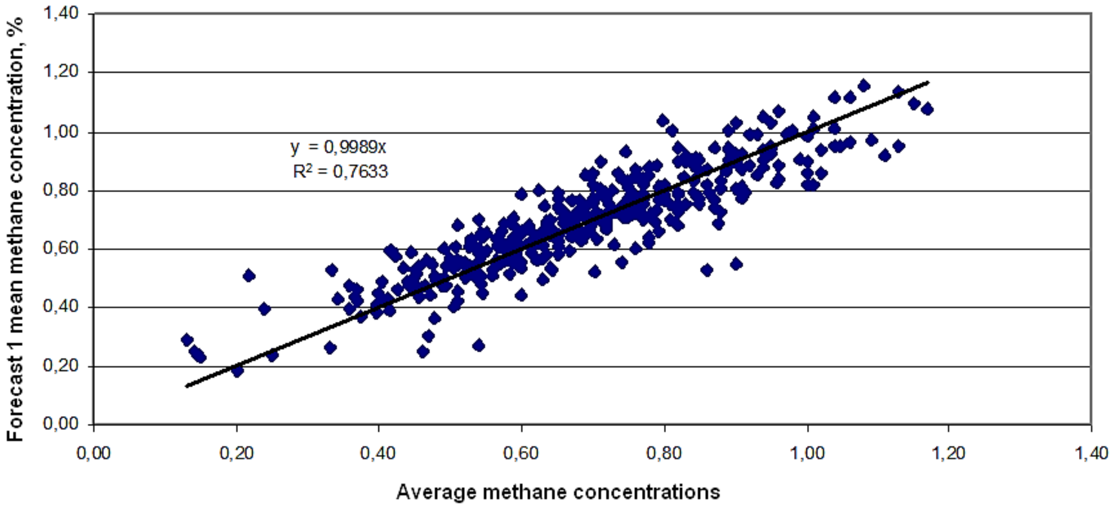

Fig. 7 Correlation of average concentrations of methane measured and forecasted at the outlet from wall area 102 (excluding methane inflow to fresh air)

Figure 8 presents the distribution of absolute errors of one-day mean methane concentration prognoses at the exhaust of the 102 longwall area (without considering the inflow of methane along with fresh air).

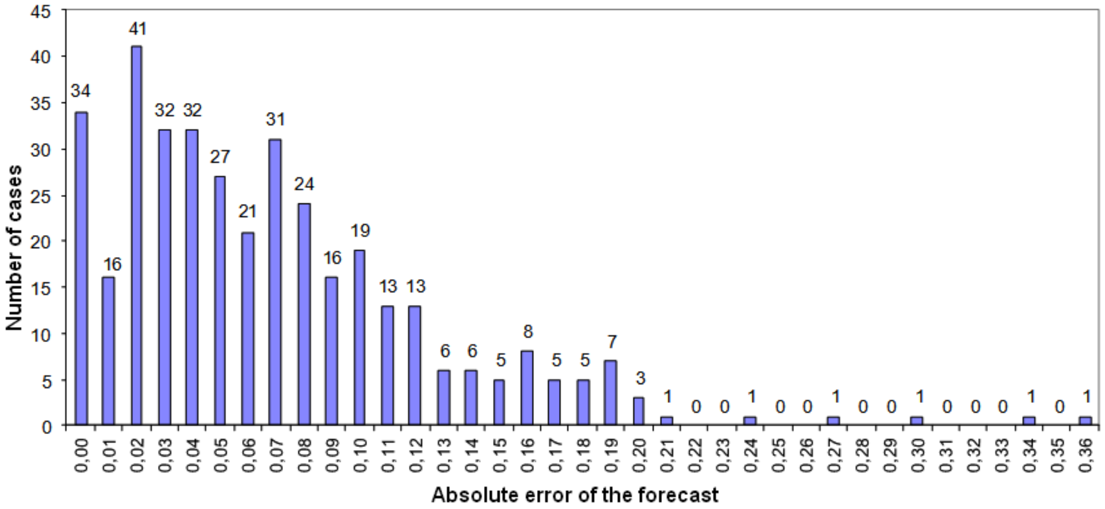

Fig. 8 Distribution of absolute error forecasts and average methane concentration at the outlet from the region of wall 102

The absolute error distribution is not a normal distribution. Most of the absolute errors exhibit low values (up to 0.1% CH_4). Errors with values exceeding 0.2% CH_4 may be considered random. The big differences between the measured and predicted values of methane concentration may also be caused by variations of the concentration in the workings resulting from natural and technical causes. Figure 9 presents the percentage of the absolute errors of prognoses in a closed range from 0.00% CH_4 up to the value indicated on the horizontal axis.

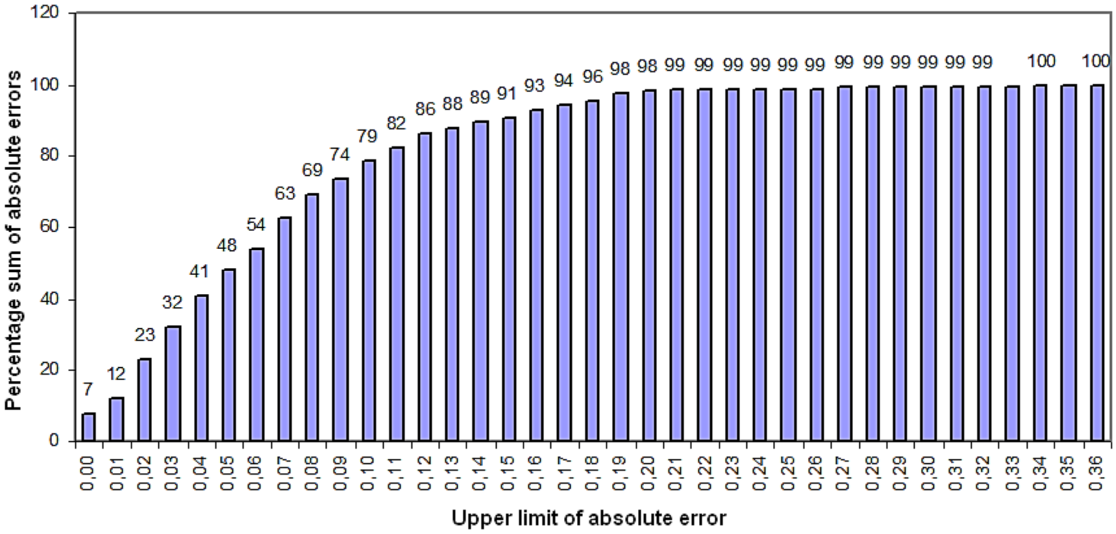

Fig. 9 Percentage of absolute errors of forecasts 1

Figure 8 indicates that within the range of absolute errors from 0.00% CH_4 to 0.1% CH_4, 79% of absolute errors are found, while 98% of the errors fall within the range from 0.00% CH_4 to 0.2% CH_4. This means that for 363 prognoses, 286 errors were smaller than 0.1% CH_4 while 357 absolute errors were smaller than 0.2%CH_4. 77 errors fall within the range from 0.1% CH_4 to 0.2% CH_4. Only 6 absolute errors exhibited the absolute value in the range from 0.21% CH_4 to 0.36% CH_4.

Figure 10 presents the percentage of the relative errors in the range from 0% to 55%. The chart indicates that 88% of all relative errors falls within the range from 0% to 20% while 99% of all relative errors fall within the range from 0% to 55%. Only 5 out of 363 relative errors exceeds the value of 55%.

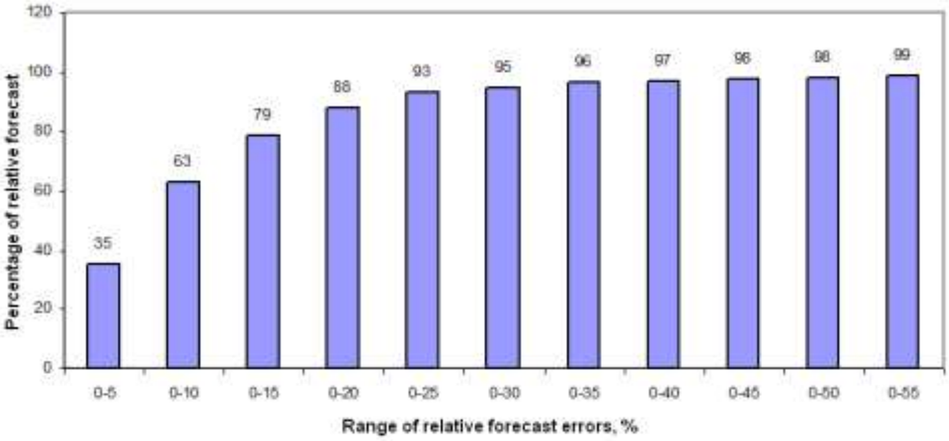

Fig. 10 Percentage of relative forecast errors 1 in the range from 0% to 50%

For practical reasons, not only the predicted mean value of methane concentration but also the probability that the actual value of the mean concentration will fall within a certain range is interesting. It was assumed, that the value of the error should not exceed 20% of the mean anticipated value. Figure 11 presents the lines connecting the predicted mean methane concentration plus and minus 20% of its value (red and green line). The red line was called the upper prognosis threshold, and the green line was called the lower prognosis threshold. The points denoting the mean value calculated based on the measurements were marked in the chart as black triangles.

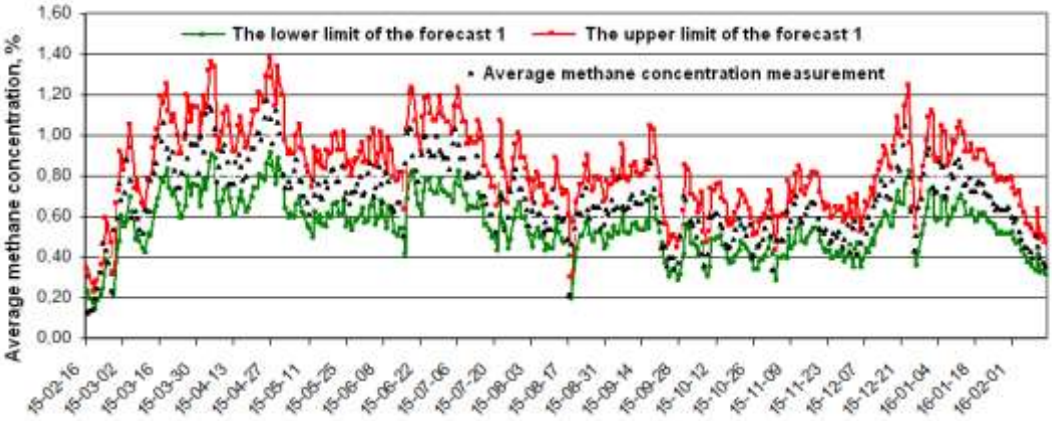

Fig. 11 Distribution of the average methane concentration measurement about the lower and upper limit of forecasts 1

In Figure 11, as one may note, most of the measured values of the mean methane concentration falls within the lines denoting the upper and lower prognosis thresholds. The calculations have exhibited that 320 out of 363 mean values fits within that range. This is 88.2% of all prognoses. The measured value exceeded the upper threshold of the prognosis in 1 out of 24 cases, which constitutes 6.6% of all the prognoses.

Based on the conducted error analysis it may be said that the presented prognosis 1 of mean methane content may be assessed as good.

The concentration of methane at the exhaust of the ventilation area is significant to the safety of work in the area of the longwall, notwithstanding the place of the methane release. The further part of the work presents the results of the prognoses of mean methane concentrations at the exhaust of the 102 longwall ventilation area while considering the methane inflowing along the fresh air.

Figure 12 presents the measured and anticipated values of the mean methane concentration at the exhaust of the ventilation area.

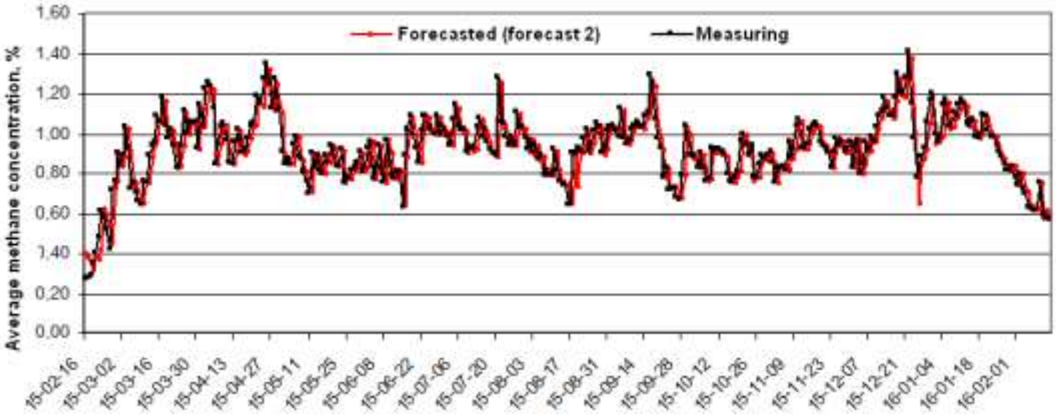

Fig. 12 Mean measured and predicted methane concentration at the exhaust of the 102 longwall ventilation area while considering the methane inflowing to the fresh air ventilation paths

The figure exhibits high conformity of the predicted and measured values of the mean methane concentration at the exhaust of the longwall ventilation area. It is better shown in the figure exhibiting the correlation of the anticipated and measured values (Fig. 13).

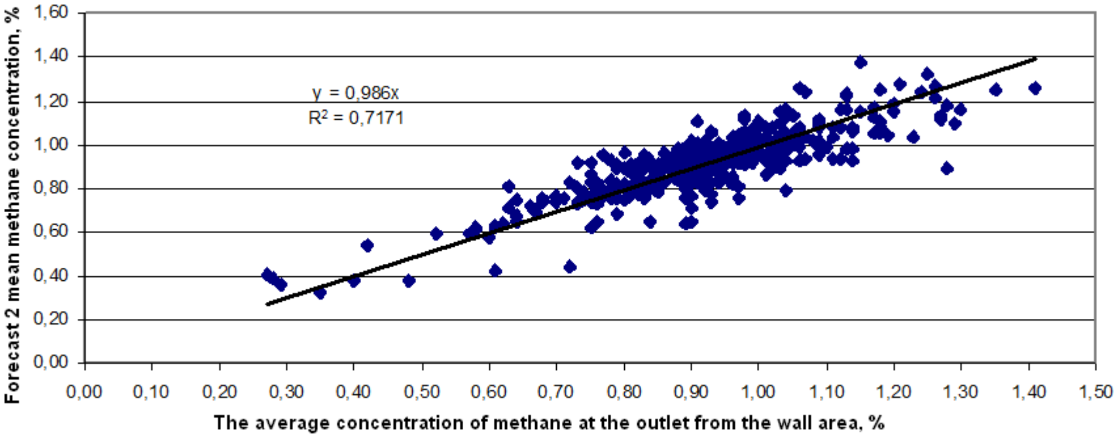

Fig. 13 Correlation of average measurement concentrations and forecasted outlet from longwall region 102 (including methane inflow to fresh air)

The value of the slope of a straight line is a = 0.986, and as such, it is close to one. The value is slightly lower than in the case of prognosis 1 (which did not consider the inflow of methane to fresh air workings).

Below, the distribution of absolute errors of the prognosis (Fig. 14) and the percentage of absolute errors in a given range have been presented (Fig. 15).

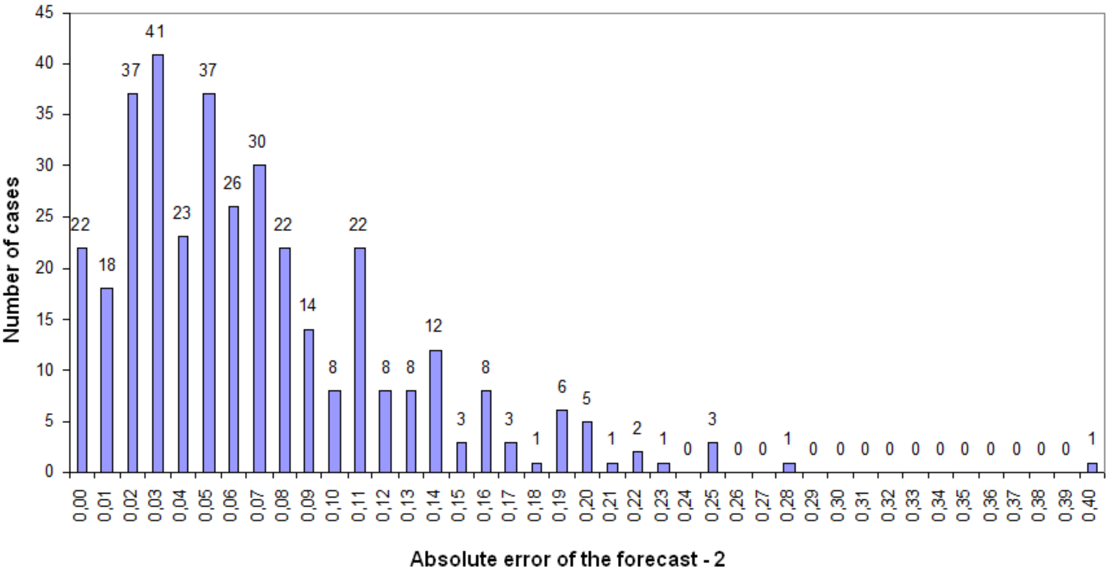

Fig. 14 Distribution of absolute errors of forecasts 2 average methane concentration at the outlet from longwall area 102

Similarly to the prognosis 1, most of the errors hold small values, while concentrating in the range from 0.00% CH_4 to 0.1% CH_4. The errors with values over 0.2% CH_4 were random errors. As exhibited by a test, the absolute error distribution is not a normal distribution.

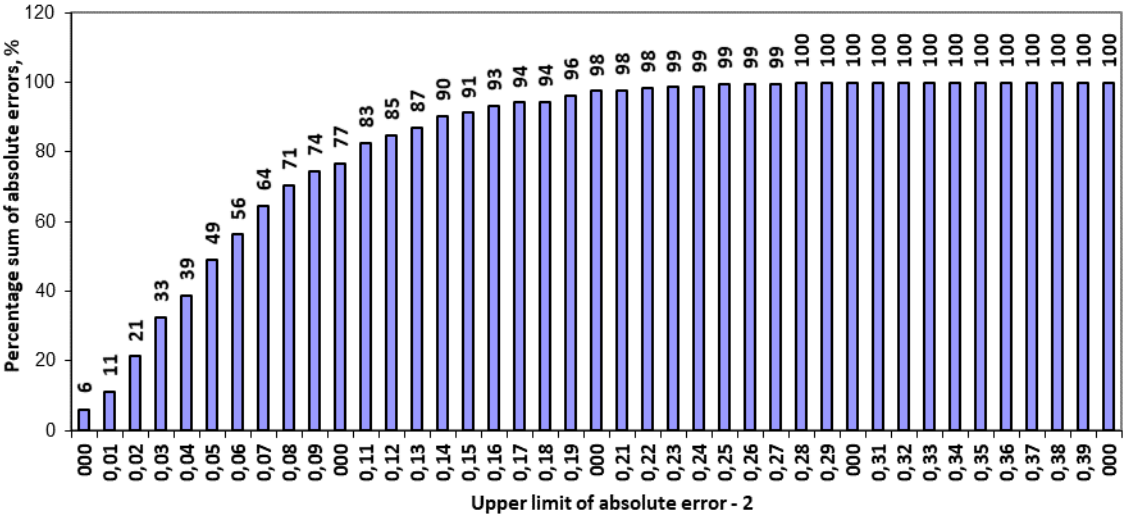

Fig. 15 Percentage of absolute errors of forecasts 2

Based upon a graph shown in Figure 15, it may be noted that 77% of absolute errors were not higher than 0.1% CH_4, and approx. 98% of errors were not higher than 0.2% CH_4. 278 errors were found in the range up to 0.1% CH_4 (out of 363 cases), while 77 errors were found in the range from 0.1% CH_4 to 0.2% CH_4. The range from 0.2% CH_4 to 0.4% CH_4 only includes 9 errors.

Figure 16 shows that the relative errors up to 10% of the measured value of the mean methane concentration constitute 74% of the total, while 94% of all the errors fit within the range from 0% to 20%. The maximal relative error of prognosis 2 was approx. 48%.

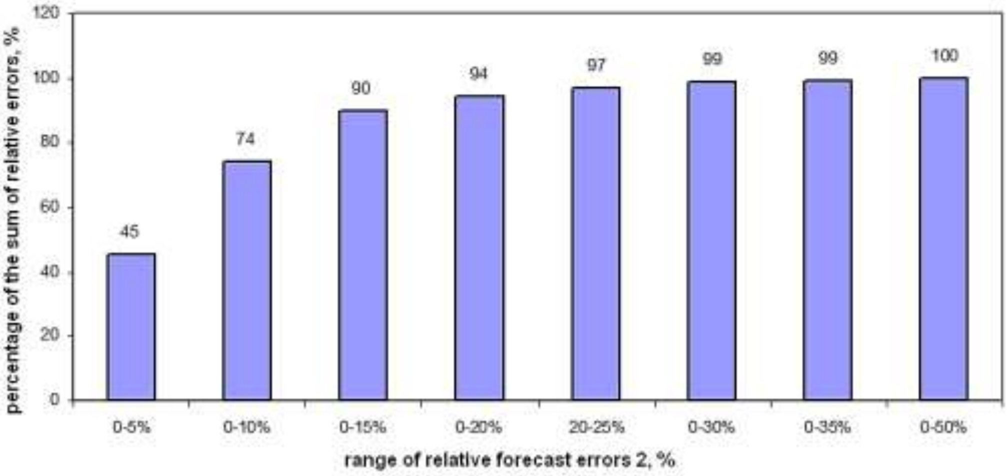

Fig. 16 Percentage of relative forecast errors 2

The positioning of the measured values of the mean methane concentration within the range of the mean predicted values plus and minus 20% of the anticipated value had been presented in Fig. 17. 344 of the cases, that is, approximately 94.8%, was found between the upper and the lower threshold. 19 cases were noted outside the range, constituting 5.2% of the total. Only 14 cases, 3.9% of the total, were found above the upper threshold of the prognosis.

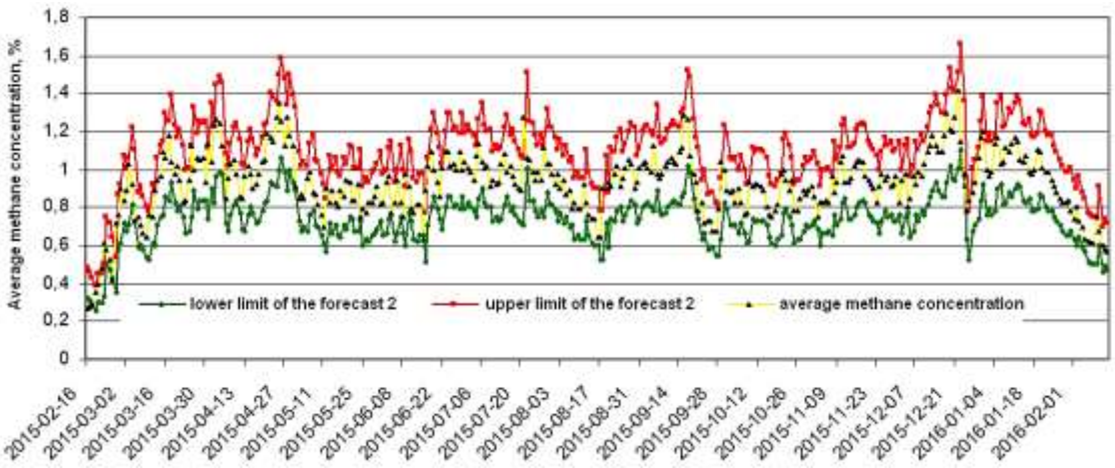

Fig. 17 Distribution of the average methane concentration measurement about the lower and upper limit of forecasts 2

The conducted error analysis indicated that the prognosis 2 of the mean methane concentration, considering methane inflow to the fresh air inflow, may be assessed as good.

DISCUSSION

The presented article concerns the longwall 102 in the 325/1 seam in the “W” coal mine, which conducted continuous exploitation, that is, operated for 7 days a week. Interruptions in the exploitation only occurred on statutory holidays.

Methane was released to the workings which served the supply of fresh air to the long wall, while in the initial period, the volumetric flow varied in the range from 1 m^3/min up to 2 m^3/min and in the following period, the variations were in the range from 2 m^3/min up to 7 m^3/min. Within the first six months, the longwall was ventilated using the “U” system, and subsequently, the “Y” system was applied.

The core part of the article is the analysis of the verifiability of the prognoses of methane concentration in the gallery serving as the outtake of air from the longwall. The measurement of methane concentration was conducted using a telemetric system (CSM-3, Figs. 1 and 2), located within approx. 15 m from the intersection of the gallery with the working supplying the fresh air.

The first prognosis (prognosis 1) did not consider the methane released to the fresh air paths, while the second prognosis (prognosis 2) concerned the entire stream of methane inflowing to the workings of the 102 longwall ventilation area. To prepare the prognoses, prognostic models developed in work Badura, 2013 were applied. Because these models concern a 5-day working week, the methods were adjusted to the case of a 7-days working week with sporadic interruptions on statutory holidays.

Absolute errors of prognoses 1 were in the range from 0.00% CH_4 to 0.36% CH_4, while errors above 0.20% CH_4 may be considered as random.

Absolute errors calculated for prognoses 1 which did not exceed 0.10% CH_4, constitute 79% of all prognoses, while 98% of absolute errors were in the range from 0.00% CH_4 to 0.20% CH_4.

Relative errors not exceeding 10% occurred in 63% of prognoses, while in case of 88% of prognoses the relative errors did not exceed 20%.

Absolute errors of prognoses 2 were in the range from 0.00% CH_4 to 0.40% CH_4. Also in case of these prognoses, the errors higher than 0.20%CH_4 may be considered random.

Absolute errors in the range of (0.00; 0.10)% CH_4 constitute 74% of all errors, while the errors from the range (0.00; 0.20)% CH_4 constitute 94% of all errors.

Relative errors not exceeding 10% occurred in 74% of prognoses, while errors not exceeding 20% occurred in 94% of prognoses.

CONCLUSIONS

- Considering the above, it is substantiated to say that both the prognoses are sufficiently accurate to be applied in mining practice.
- Taking into account the conducted analysis, it is justified to state that both forecasts that do not take into account the inflow of methane to the excavations supplying air to the wall and taking into account the inflow are sufficiently accurate for mining practice.
- The one-day prognosis of methane concentration in areas of longwalls may also be used for the balance of methane amounts and predict the methane concentrations in ventilation shafts which may facilitate its use as a source of energy.
- The outflow of methane to mine workings causes the occurrence of methane explosion or ignition, as well as the formation of an uninhabitable atmosphere. This leads to a threat to human life.

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Abstract.

The first part of the paper concerns the natural deposition conditions of the 325/1 seam in the “W” coal mine, in the 102 longwall mining panel. It also presents the most important technical conditions regarding the exploitation at this longwall. To characterize the methane hazard in the longwall area, the parameters of ventilation and total methane concentrations as well as the volumetric flowrate of methane captured by the methane removal system, have been presented graphically. A significant part of the methane flow in the longwall area was released to the air flowing to the longwall. The most significant part of the article is the presentation and analysis of the results of prognoses of mean methane concentrations at the exhaust of the longwall area. The accuracy of the prognoses of methane concentration was verified using two methods: while not considering the release of methane to the air flowing to the longwall and while considering the total flowrate of methane to the ventilation air in the area of the 102 longwall. The method of forecast presented in the article has so far been checked for a 5-day and 6-day work day, as well as for walls operating in a non-regular mode. The article refers to the wall operating in a continuous mode, which required adaptation of the proposed method to this mode. The application of the one-day forecast proposed in the article allows for undertaking temporary methane prevention measures enabling safe use of the wall.

Keywords: continuous exploitation, methane content, mean methane concentration, methane concentration prognosis