EVALUATION OF PRESENT FINDINGS OF POWER POTENTIAL USAGE OF GAS FROM CLOSED UNDERGROUND

VYHODNOCENÍ DOSAVADNÍCH POZNATKŮ O VYUŽITÍ ENERGETICKÉHO POTENCIÁLU PLYNU Z UZAVŘENÉHO PODZEMÍ

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Abstract

Recently a sharp increase in price of crude oil and natural gas has been recorded. The response of the society to this fact is rather embarrassed. We, at the Institute of Mining Engineering, track this mentioned reality and look for ways of moderating the impact of this circumstance.

After the intense reduction of extraction at underground mines which occurred after the year 1989 coal reserves at the abandoned mines were lost. However, after closing the mines a gas exit from the underground occurs at a certain development of barometric pressure. In the gas mixture methane is present sometimes in not negligible concentrations. In a series of cases the escaping gas endangered also the local settlement. In order to mitigate the mentioned dangerous situation in the Ostrava-Karvina Coalfield a number of degassing boreholes has been performed.

The measurement results at the boreholes led to an idea of possible utilization of the gas as energy resources.

However, the new situation in prices of basic energy resources requires this problem to be revaluated and possibilities of utilization of alternative resources from the abandoned underground to be found.

Abstrakt

V poslední době jsme zaznamenali prudký růst cen nafty a zemního plynu. Reakce společnosti na tuto skutečnost je poněkud rozpačitá. Na Institutu hornického inženýrství a bezpečnosti zmíněnou realitu sledujeme a hledáme možnosti, jak zmírnit dopad této okolnosti.

Po intenzivní redukci těžby, která nastala po roce 1989, byly ztraceny zásoby uhlí v uzavřených dolech. Ale po uzavření také dochází, při určitém vývoji barometrického tlaku, k výstupu plynu z podzemí. Ve směsi plynů je přítomen metan, někdy v nezanedbatelné koncentraci. V řadě případů tento vystupující plyn ohrozil také osídlení. Ke zmírnění uvedeného nebezpečí byla provedena v ostravsko-karvinském revíru řada odplyňovacích vrtů.

Podle výsledků měření na těchto vrtech se nabízela myšlenka možného využití plynu, jako zdroje energie. Nová situace ve vývoji cen energetických zdrojů ale vyžaduje, aby se tento problém znovu přehodnotil a hledaly se možnosti i využití alternativních zdrojů z uzavřeného podzemí.

Key words

mining, gas, coal gas capacity, underground, coal bad

1 INTRODUCTION

During last years likely from the turn of the century we record a sharp increase in prices of crude oil and natural gas. The actual responses of the society to the relatively unpleasant phenomenon are rather embarrassed. Within the area of mining engineering we realize the facts and search the ways of solving the impact of the mentioned situation at least partially.

After the sharp damping of mining activity of underground mines that occurred after the year 1989 a possibility of exploitation of coal resources of the abandoned mines under the present conditions was beyond redemption. However, after closing them a gas escape from the underground occurs at a certain course of barometric pressure. In the gas mixture methane is presented frequently in relatively high concentrations. In many cases the gas endangered even the local settlement. In order to mitigate the dangerous situation the responsible organizations in the Ostrava-Karvina Coalfield performed a number of degassing boreholes.

Based on the measurement results at the boreholes considerations occurred of a possible utilization of the gas as an energy resource.

Even number of tests has been carried out, especially suction at the mentioned boreholes, however for a number of reasons the practical utilization of this alternative was reduced only to isolated cases.

However, the new situation in prices of basic energy resources requires the problem to be introduced again and an alternative resource to be found from the closed underground.

For an objective assessment of such possibilities it is necessary first briefly to resume findings of the works that have been performed so far.

2 FINDINGS FROM THE HRUSOV MINE LOCALITY IN THE OSTRAVA-KARVINA COALFIELD

In the Hrusov Mine locality in the years 1998 and 1999 nearly unexpected gas escapes became evident in a quite considerable intensity. Considering the almost emergency situation with a direct inhabitants' safety hazard and endangering of individual houses there was drilled a series of methane drainage boreholes in this period there.

At the moment of the degassing boreholes installation gas pressure values (more precisely, difference between pressures in the atmosphere and in the borehole) and concentrations of gases as CH_4, O_2 and CO_2 are measured there in different time intervals.

In the interested area mine works are situated under the built-up area and relatively in a small depth below the surface including the worked out and unworked parts of the seams no. 8, 9, 10 and Frantisek that were extracted in the past century. Even tectonic disturbances and degassing boreholes are present here.

In an axonometric projection (Fig. 1) in the area of The Hrusov Mine there are depicted locations of main mine works, methane drainage boreholes and tectonic disturbances.

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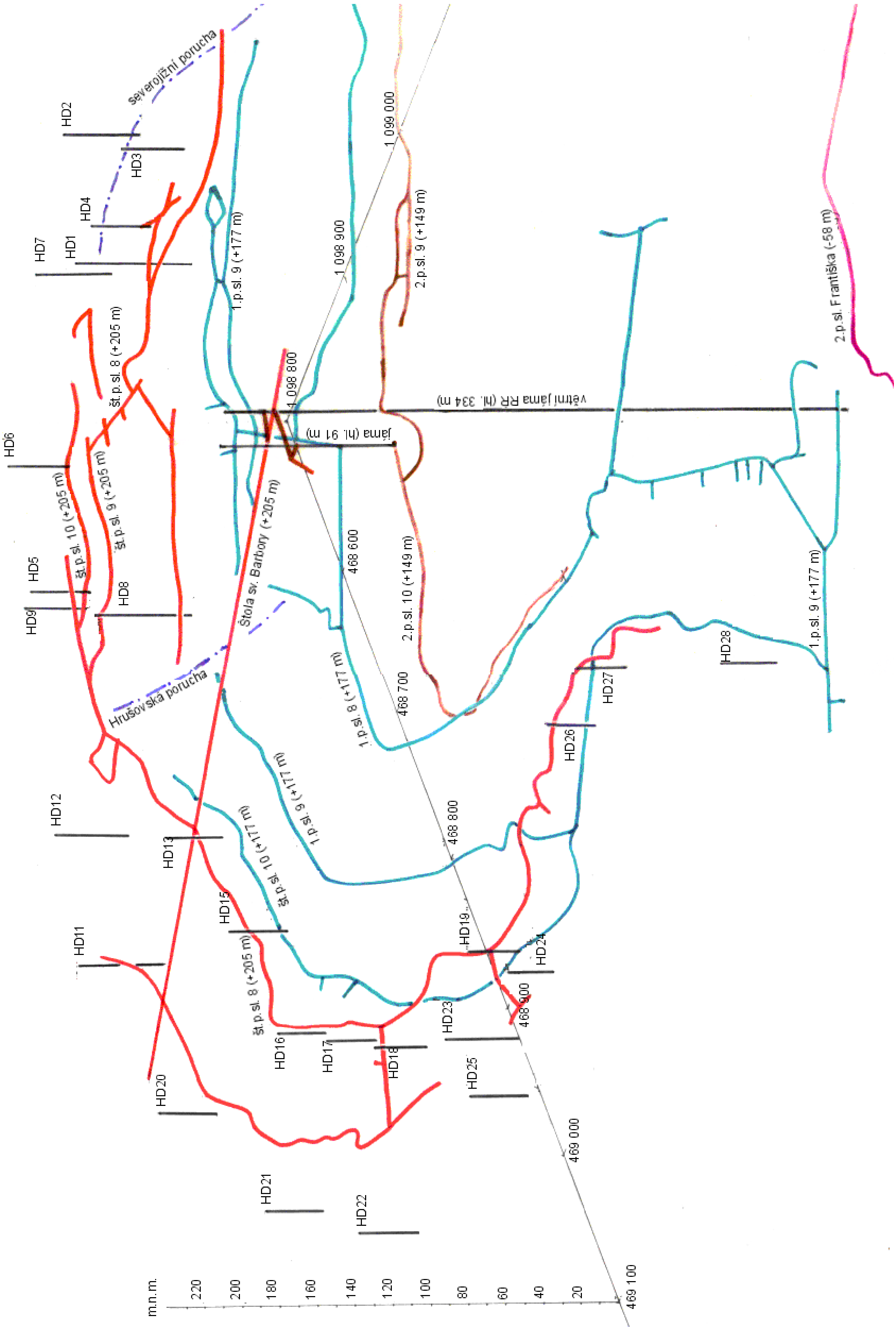

Fig. 1 Axonometric view of the underground part of the Hrusov Mine area

Boreholes measurement results

Locations of the individual boreholes in the area of the Hrusov Mine result from Table 1.

Tab. 1 Overview of boreholes and their coordinates X,Y and Z

Borehole	Depth [m]	Affected seams	Z [m.a.s.l.]	Y	X
HD1	60,5	8 a 9	236,2	468651,63	1099063,55
HD2		9	236,5	468595,52	1099096,03
HD3	32,3		237,2	468653,69	1099147,9
HD4	30,0		237,6	468650,56	1099096,23
HD5	32,4	10	229,6	468710,03	1098902,17
HD6	32,6	9 a 10	228,2	468669,84	1098932,83
HD7	40,0	9	233,6	468616,43	1099027,36
HD8	50,5	8	231,1	468789,12	1098960,12
HD9	32,0	10	229,3	468716,98	1098892,27
HD11	45,0		223,2	468877,35	1098810,26
HD12	40,0		224,5	468806,68	1098829,11
HD13	30,5	8, 9 a 10	225,7	468915	1098933,04
HD15	30,0	8, 9 a 10	225,8	469001,77	1098956,31
HD16	25,9	8, 9 a 10	224,2	469067,11	1098956,06
HD17	26,5		222,0	469121,4	1099003,25
HD18	25,4	8, 9 a 10	223,3	469161,38	1099049,91
HD19	26,4		219,4	469212,32	1099161,17
HD20	31,0		224,4	469000,24	1098830,01
HD21	30,0		222,6	469128,95	1098893,08
HD22	32,4		220,6	469211,82	1098962,78
HD23	38,0		218,9	469222,56	1099107,41
HD24	26,0		219,2	469262,29	1099190,13
HD25	32,0		218,8	469266,51	1099107,76
HD26	26,0		225,2	469217,42	1099314,57
HD27	26,0		227,3	469227,78	1099369,75
HD28	27,5		220,2	469354,56	1099495,81
D30	27,0		218,6	469492,23	1099714,01

The results show the degassing boreholes did not always work as was expected especially as for their gas yield and drainage from the wide underground. Based on the measurement results from June 1999 I would divide the tracked boreholes to three groups.

Active boreholes:

HD1, HD4, HD5, HD6, HD7, HD8, HD9, HD13, HD15, HD16, HD17, HD18, HD20 - Total 13 boreholes

Absolutely "dead" boreholes:

HD19, HD23/1, HD26, HD27 a HD3 - Total 5 boreholes

Poorly yielding boreholes:

HD11, HD12, HD21, HD22, HD24, HD25, HD28, HD30 - Total 8 boreholes. Barometric pressure at the time of an inspection was 100 700 Pa to 100 950 Pa. The measurement results from August 1999 show then the following information.

Active boreholes:

HD1, HD2, HD5, HD6, HD7, HD8, HD9, HD13, HD15, HD16, HD18 - Total 11 boreholes

Absolutely "dead" boreholes:

HD3, HD11, HD12, HD17, HD19, HD21, HD22, HD23/1, HD25, HD26, HD27, HD28 and HD30 - Total 13 boreholes

Poorly yielding boreholes:

HD4, HD20 and HD24 - Total 3 boreholes. Barometric pressure at the time of an inspection ranged from 100 930 Pa to 101 970 Pa.

It is known that in order to be able to make an analysis of the gas output from the damped mines it is necessary to find out (measure) at least the following values:

- Gas pressure at borehole
- Volume or mass flow rate
- Gas concentration

An example of such measurement report is shown in Tab. 2.

Tab. 2 An example of the measurement report in the area of the Hrusov Mine

Bore-hole number	Date	Time	Baromet. pressure [kPa]	Borehole trend	Volume flow rate $[m^3 . s^{-1}]$	Borehole pressure	Press. trend	Gas concentration [%]		
								CH_4	O_2	CO_2
HD 1	14.7.2000	9:40	100,75	blows hard		210,00	decr.	59	1,5	
HD 2	14.7.2000	9:54	100,70	blows		43,00	decr.	59	3,3	
HD 3	14.7.2000	10:07	100,65	sucks		-3,00	decr.	0	20,3	
HD 4	14.7.2000	10:11	100,60	sucks		neměř.	decr.	0,2	20,6	
HD 5	12.6.2000	8:50	102,00	blows	0,0072	5,00	incr.	22	12,7	3,3
HD 6	12.6.2000	10:00	102,00	blows	0,0072	95,00	incr.	51,6	4,9	5,8
HD 7	14.7.2000	9:48	100,75	blows		190,00	decr.	57	4,1	
HD 8	12.6.2000	10:13	102,00	blows		97,00	incr.	63	0,3	8
HD 9	12.6.2000	9:27	102,00	blows softly			incr.	14,3	15	2,2
HD 11	14.7.2000	10:46	100,60	blows softly		8,00	decr.	2,9	18,4	
HD 12	14.7.2000	9:32	100,75	sucks		-3,00	decr.	0	20,5	
HD 13	14.7.2000	9:15	100,75	blows		31,00	decr.	24	6,9	
HD 15	14.7.2000	9:07	100,80	blows		40,00	decr.	31		
HD 16	11.7.2000	15:45	100,40	blows		63,00	low	40	1,4	
HD 17	11.7.2000	14:15	100,40	blows softly		6,00	low	6	19,1	
HD 18	14.7.2000	10:57	100,60	blows		70,00	decr.	32	3	
HD 19	12.6.2000	10:37	102,00	sucks		-20,00	incr.	0	19,9	
HD 20	14.7.2000	10:22	100,60	blows		29,00	decr.	26	6,1	
HD 21	11.7.2000	15:50	100,40	blows		17,00	low	6	15,4	
HD 22	11.7.2000	14:06	100,40	sucks		-10,00	low	0	20,8	
HD 23	14.7.2000	11:20	100,55	neutral		0,00	decr.	0	20,8	
HD 24	11.7.2000	14:47	100,40	neutral		0 - 1	low	0	20,6	

Bore-hole number	Date	Time	Baromet. pressure [kPa]	Borehole trend	Volume flow rate [$m^3 . s^{-1}$]	Borehole pressure	Press. trend	Gas concentration [%]		
								CH_4	O_2	CO_2
HD 25	14.7.2000	11:08	100,55	neutral		0,00	decr.	0	20,7	
HD 26	11.7.2000	15:15	100,40	sucks		0,00	low	0	Z0,3	
HD 27	11.7.2000	15:02	100,40	sucks		0,00	low	0	20,4	

Within the solution of the grant project [3] measurements have been performed at boreholes with the agreement of and in cooperation with the DPB, a.s. organization, the then OKD, in the period of 18th – 23rd September 2000 in the area of the Hrusov Mine namely in such modes, when the boreholes functioned without suction and later with application of a suction plant.

Concentrations of gases such as methane, oxygen, carbon oxide, pressure (pressure difference between the borehole and atmosphere), speed of gas flow were measured. From the flow speeds the volume flow rate is recalculated. In Fig. 2 there is an outline of the degassing borehole facility as presented in [3].

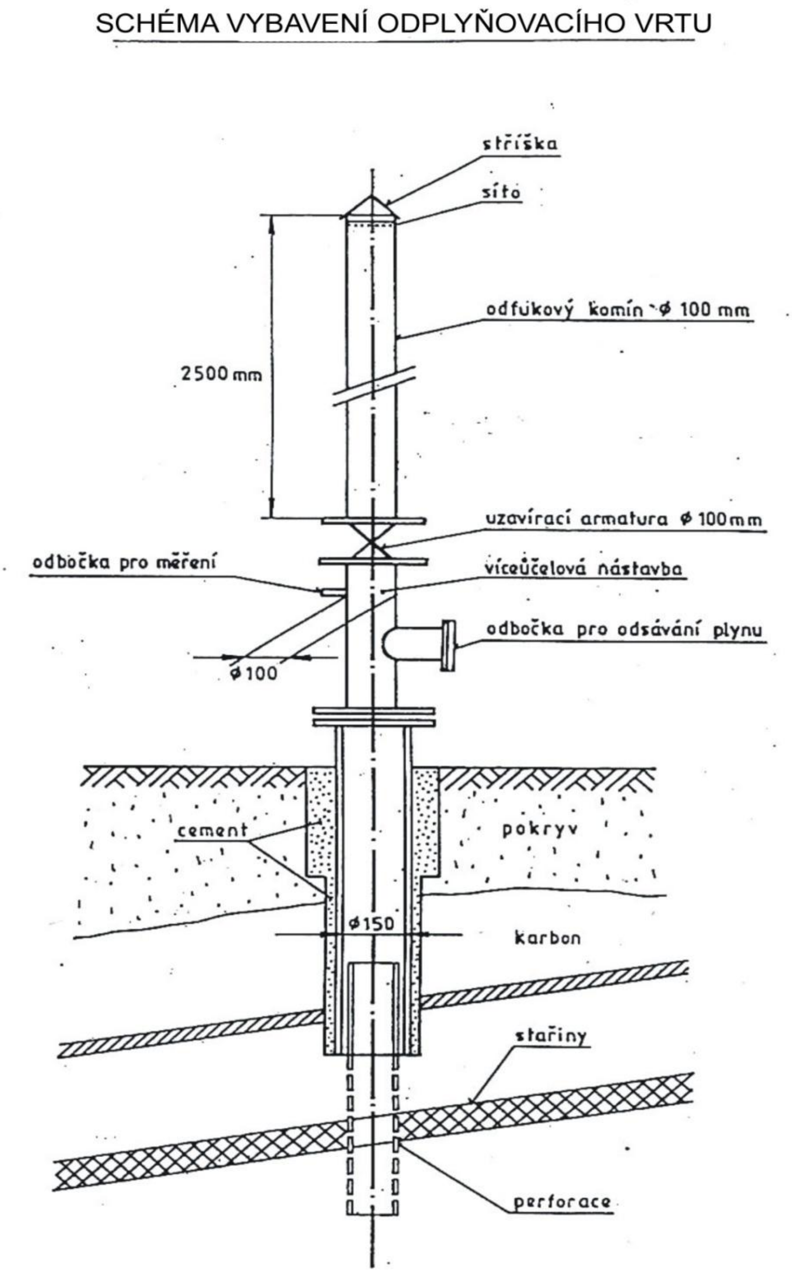

Fig. 2 Outline of degassing borehole [3]

From the extensive set of measurements [3] I mention here the results of the suction station operation that was gradually relocated to 3 different boreholes, the effective radius of suction and other parameters to be verified.

Tab. 3 Results of the MOS suction station operation at the Hrusov Mine

Date and time	Q (m3/h)	CH4 (%)	CO2 (%)	2(%)	Suction (mm Hg)	Delivery (mm Hg)
18.9.2000 10:00	Operation commenced at HD6					
18.9.2000 10:00	100	56	7	0,5	70	5
18.9.2000 15:00	240	47,2	7,82	0,22	230	90
18.9.2000 20:00	240	44,9	7,87	0,25	230	90
19.9.2000 1:00	220	42,4	7,92	0,11	210	80
19.9.2000 6:00	220	41,4	7,97	0,16	215	110
19.9.2000 11:00	300	40,6	8	0,25	180	80
19.9.2000 16:00	300	39,6	8,05	0,4	180	80
19.9.2000 21:00	310	39,8	8,07	0,3	180	60
20.9.2000 2:00	300	40	8,2	0,2	175	54
20.9.2000 7:00	300	40,6	8,1	0,1	180	50
20.9.2000 8:45	MOS at HD6 shut down					
20.9.2000 15:00	Operation commenced at HD18					
20.9.2000 15:00	420	5	0,25	20,6	30	30
20.9.2000 20:00	230	19,7	7,75	10,47	30	100
21.9.2000 1:00	300	5	7,6	6,1	30	130
21.9.2000 6:00	300	4	7,2	7,2	28	120
21.9.2000 11:00	310	3,7	6,53	8,5	30	120
21.9.2000 11:30	MOS at HD18 shut down					
21.9.2000 15:30	Operation commenced at HD1					
21.9.2000 20:00	470	43	8,3	0	30	30
22.9.2000 1:00	360	40,8	8,1	0,2	24	28
22.9.2000 6:00	370	38,3	8,4	0,1	20	20
22.9.2000 11:00	370	35,8	8,5	0,1	20	30
22.9.2000 16:00	450	33,1	8,51	0,12	25	35
22.9.2000 21:00	300	30,3	8,95	0,3	15	17
23.9.2000 2:00	300	27,9	8,61	0,58	15	17
23.9.2000 7:00	270	26	8,6	0,9	15	18
23.9.2000 10:00	300	24,5	8,6	1	15	25
23.9.2000 10:00	MOS at HD1 shut down					

It results from Table 3 that during the suction tests running in the days of 18th – 23rd September 2000 the suction station was gradually connected to the boreholes HD6, HD18 and HD1.

During the suction test also a suction radius from the borehole was found out [1]. During the suction the boreholes HD6 and HD18 were able to affect only a small area in their immediate surroundings.

A larger area of influence became evident when suctioning at the borehole HD1. It is possible to find several reasons of the situation. The borehole HD1 is by its altitude a most highly set borehole in the entire area and at the same time it is the deepest borehole of all. It is assumed as well that the HD1 borehole is located nearby a tectonic disturbance which supplies the entire area by the mine gas flowing from the Frantisek seam. According to the under-pressures that occurred during the suction at the HD1 borehole even at the edge of the interested area one can assume that the properties were not a principal factor affecting the efficiency of the suction.

The substantial factor which could affect the suction was the course of barometric pressure, see Fig. 3.

With a view to answer the questions values were measured at the boreholes whre an effective radius was expected from HD1. I have chosen for the presentation the most suitable data from the boreholes HD2, HD8 and HD11.

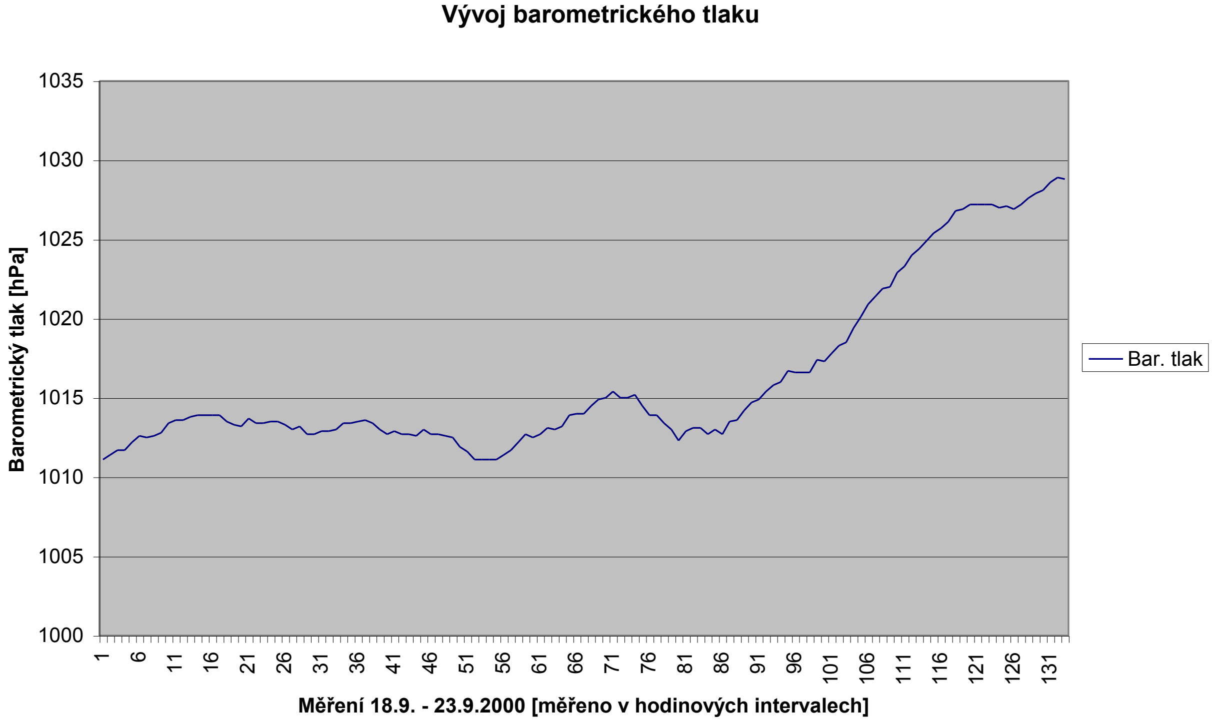

Fig. 3 Development of barometric pressure in the days of 18th September 2000 – 23rd September 2000

The measured values of the selected boreholes HD2, HD8 and HD11, are only from the date of 22nd September 2000 from 10.00 a.m., when the barometric pressure started to increase. From Table 4 thus it is not possible to determine unambiguously whether the suction radius was caused by the suction station. It rather seems that the drop of pressure at the boreholes HD2, HD8 and HD11 (negative sign at the under-pressure value) relates to the course of the barometric pressure.

From the measurements at the time when the suction stopped it is known that if the values of the barometric pressure are approximately over 1022 hPa, any flow of air masses to the underground does not occur at most of boreholes.

Tab. 4 Course of under-pressure at the boreholes HD2, HD8 and HD11 during suction at HD1

Date, time	Bar.press.	HD2	HD8	HD11
	(hPa)	dp (Pa)	dp (Pa)	dp (Pa)
22.9.2000 6:00	1018,5			
7:00	1019,4			
8:00	1020,1			
9:00	1020,9			
10:00	1021,4	7	-287	
11:00	1021,9	-53	-324	

Date, time	Bar.press.	HD2	HD8	HD11
22.9.2000 12:00	1022			-254
13:00	1022,9			-276
14:00	1023,3			
15:00	1024	-50	-356	-274
16:00	1024,4			
17:00	1024,9		-456	-378
22.9.2000 18:00	1025,4			
19:00	1025,7			
20:00	1026,1			
21:00	1026,8			
22:00	1026,9			
23:00	1027,2			
23.9.2000 0:00	1027,2			
1:00	1027,2			
2:00	1027,2			
3:00	1027			
4:00	1027,1			
5:00	1026,9			
23.9.2000 6:00	1027,2			
7:00	1027,6			
8:00	1027,9	-48		
9:00	1028,1		-594	
10:00	1028,6		-676	

The gathered gas energy potential during the suction at the boreholes of the Hrusov Mine.

While evaluating the energy potential of the gas gathered during the suction just theoretical parameters are assessed namely those of a needful performance of the suction plant and gas energy.

We find out that for the period of the suction (about 45 hours) at the HD6 borehole a relatively stable concentration of CH_4 (40 %) was maintained, but the needful depression of the MOS suction unit had to be 26 600 Pa at the average volume flow rate $Q_v = 8{,}3 \cdot 10^{-2} m^3 \cdot s^{-1}$. The needful performance of the suction unit is

$$P = Q_v \cdot \Delta p \qquad [W] \qquad (1)$$

where: P - performance [W]

Q_v - volume flow rate [$m^3 . s^{-1}$]

Δp - depression [Pa]

$$P = 2216 \, W$$

The expected energy utilization then would be at 40% concentration of CH_4

$$P_{tep} = q \cdot Q_v \qquad [W] \qquad (2)$$

where: P_{tep} -heat output of the gas [W]

q - calorific value of methane at the given concentration [$J.m^{-3}$]

Q_v - volume flow rate [$m^3 . s^{-1}$]

After substitution for Q_v and q in the equation (2)

$$P_{tep} = 12.10^6 . 8{,}33.10^{-2} = 10^6 W = 1000 kW \quad (3)$$

By analogy for the HD1borehole

P = 222 W

$P_{tep} = 8.706.10^6 . 8{,}33.10^{-2} = 0{,}725.10^6 = 725 kW$

This comparison implies an economic effectiveness of gas gathering. However, it is necessary to mention that here we come out just from the shorter course of the suction test. At the HD6 borehole considering the needful high depression of the suction plant we gather the gas from a relatively narrow space (storage). At the HD1 borehole a significant decrease of the methane concentration (from 43% to 24,5%.) occurs during the 38-hour test. In the given situation of the Hrusov Mine at the boreholes depth below 60 m the gas utilization is not real.

The results of the suction tests in further localities entitled us to say that the conclusions are analogous as in case of the boreholes at the Hrusov Mine.

Suction test results in the area of the Jakovlecky Mine.

The suction test ran for the period of 24 hours from 14th October 2002 to 15th October 2002. 15.10.2002.

The suction was performed at the Jd14 borehole with a relatively low depression of 800 Pa and average volume flow rate $Q_v = 0{,}13 m^3 \cdot s^{-1}$. However, the concentration of CH_4 did not exceed 20 %, so to consider a utilization of energy potential is unfounded.

At the Jd30 borehole, where the suction test was performed also for the period of 24 hours the methane concentration was zero throughout the test.

Suction test result in the area of Petrkovice.

Relatively favourable results the suction test showed at the MV39 borehole. The suction was performed for the period of 70 hours from 26th May 2003 to 29th May 2003. The mean values were as follows. The suction plant depression was 2130 Pa, volume flow rate 500 $m^3 \cdot s^{-1}$, methane concentration 40 %.

Analogous results were found out even at the MV40 borehole. The suction was performed for the period of 24 hours from 16th October 2002 to 17th October 2002. The average values were as follows. The suction plant depression was 533 Pa, volume flow rate 260 $m^3 \cdot s^{-1}$, methane concentration 46 %.

The results at both boreholes give certain premises of gas utilization for energy purposes.

Suction test results in the area of Orlova.

The suction tests were carried out at the boreholes OV5, OV6, OV7, OV11 and MOV2.

At MOV2 there was performed a shorter test on 30th May 2002 for the period of 4 hours. The average values were as follows. The suction plant depression was 799 Pa, volume flow rate 90 $m^3 \cdot s^{-1}$, methane concentration 30 %.

At OV5 the suction was performed from 27th May 2002 to 29th May 2002 for the period of 40 hours with the following results. The suction plant depression ranged from 399 to 933 Pa, volume flow rate from 15 to 240 $m^3 \cdot s^{-1}$, methane concentration from 45 to 20 %.

At OV6 the suction was performed from 30th June 2002 to 1st August 2002 for the period of 44 hours with the following results. The suction plant depression was 933 Pa, volume flow rate 300 $m^3 \cdot s^{-1}$, methane concentration 12 %.

At OV7 the suction was performed from 12th August 2002 to 14th August 2002 for the period of 48 hours with the following results. The suction plant depression was 133 Pa, volume flow rate 90 to 350 $m^3 \cdot s^{-1}$, methane concentration 32 to 0 %.

At OV11 the suction was performed from 29th May 2002 to 31st May 2002 for the period of 48 hours with the following results. The suction plant depression ranged from 266 to 5 332 Pa, volume flow rate 40 to 90 $m^3 \cdot s^{-1}$, methane concentration 42 to 0 %.

Partial conclusion to the suction test results.

It results from the presented overview that except for the Petrkovice locality the results of the suction tests do not give a prerequisite to economic utilization of the gas from the underground of the abandoned mines.

Utilization of the gas reserve from the closed Paskov Plant, Paskov Mine.

From the localities that have already been closed in OKR the gas from the Paskov Plant, the Paskov Mine is utilized as a suitable energy resource. [2]. From there by means of the degassing system ca 1370 $m^3 \cdot h^{-1}$ of methane with the concentration of 70 % has been gathering and supplying to the energy supply network since its closing in the year 1994. A great part of the successful solution consists in the advisable way of closing coal shafts and in preservation of the degassing station function. The method of closing shafts is presented in Fig. 4.

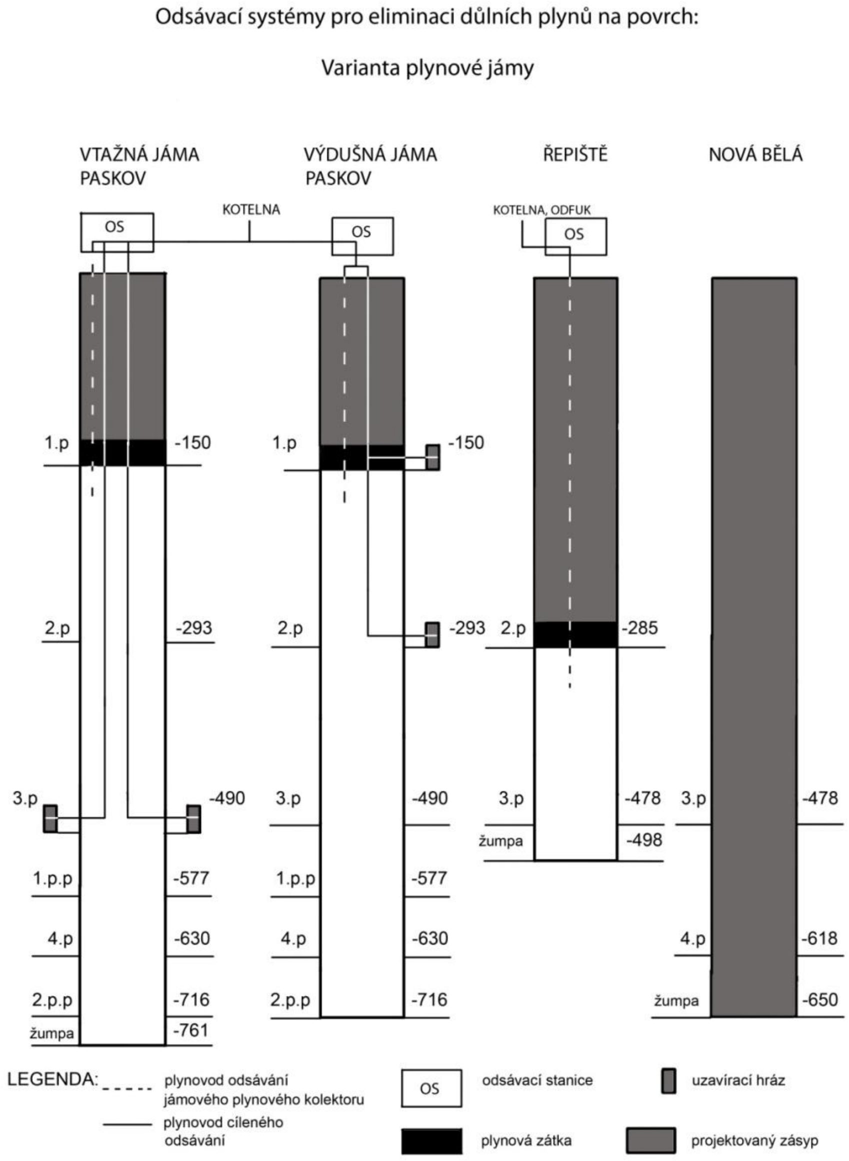

Fig. 4 The method of closing shafts at the Paskov Plant.[2]

As it is known this originally separate mine was open by four shafts. It results from Fig. 4 that after the damping of extraction in three shafts the gas (degassing) pipeline was retained intervening up to the shaft level -

490 m. But also at the levels -150 m and –293 m the gas pipeline leads behind the gas plugs and therefore the gas drainage is enabled from considerably large gaps.

Meanwhile the case in OKR is unique, however just these findings should be used in further course of damping that is expected in this locality.

From comparing the presented examples the gas suction at the degassing boreholes of the Hrusov Mine, Jalovecky Mine, Petrkovice and Orlova and the gas drainage by suitable closed shafts from the Paskov Plant the following finding results: In order to gather sufficient gas reserves as an energy resource it is necessary to apply the system of closing mining works connecting the underground with the surface with keeping the degassing pipeline drained to greater depths.

Meanwhile the possibility of utilization of alternative resources seems to get no needful support. To a great extent it relates to a relative economic effectiveness and electric energy price setting in the public supply mains.

3 CONCLUSION

In the presented article possibilities of gathering gas from the abandoned underground in the Ostrava-Karvina Coalfield as a power supply are assessed. It results from the analysis that for achievement of the goal two approaches will be needful.

In the already closed localities to verify gas reserves in greater depths because the experience with its arranged suction from the greater depths confirms a higher resource yield.

At mines that are going to be closed to implement the system of the degassing pipeline in the works connecting the underground with the surface (shafts) so that the gas from larger areas could be drained.

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[1] Lát, J.: *Výstupy plynů z dolu na povrch v oblastech s ukončenou hornickou činností*; Uhlí Rudy, 7/2000; str. 10 – 14

[2] Trejbal, Z.: *Možnosti využití zásob plynu v uzavřeném podzemí jako zdroje energie*. Sborník vědeckých prací HGF VŠB-TUO, v tisku

[3] Výsledky měření v terénu, zejména na odplyňovacích vrtech a během odsávacích zkoušek, v průběhu řešení Grantového úkolu č. 105/98/KO45. VŠB-TUO, říjen 2003

RESUMÉ

Na základě výsledků měření na vrtech se vyskytly úvahy o možném využití plynu jako zdroje energie. Byla provedena i řada zkoušek, zejména odsávání na odplyňovacích vrtech, ale z řady důvodů se praktické využití této eventuality omezilo jen na ojedinělé případy. Nová situace v cenách základních zdrojů energie ale vyžaduje, abychom tento problém znovu nastolili a pokusili se nalézt alternativní zdroj z uzavřeného podzemí.

Z přehledu odsávacích zkoušek vyplývá, že až na lokalitu Petřkovice, nedávají výsledky předpoklad k ekonomickému využití plynu z podzemí uzavřených dolů.

Srovnáním uvedených příkladů odsávacích zkoušek plynu na odplyňovacích vrtech lokalit Hrušovký, Jaklovecký důl, Petřkovice a Orlová a svedení plynu vhodně uzavřenými jámami ze závodu Paskov vychází poznatek, že pro získání dostatečné zásoby plynu jako energetického zdroje je nutno aplikovat systém uzavření děl spojujících podzemí s povrchem s ponecháním degazačního potrubí, svedeného do větších hloubek.

Zatím však ještě využívání alternativních zdrojů nezískává potřebnou podporu. Do značné míry to souvisí s relativní ekonomickou efektivností a stanovení ceny elektrické energie v distribučních sítích.