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DETERMINATION OF THE TECHNOLOGICAL PARAMETERS OF BOREHOLE UNDERGROUND COAL GASIFICATION FOR THIN COAL SEAMS

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Abstract
In this article the characteristics of the criteria of borehole underground coal gasification for thin coal seams are defined. The thermal and material balance calculations for coal seam gasification processes are also explained. The construction, method of in situ gasifier preparation, and the sequence of coal seam gasification for area No 1 (located in the field of Solenovsk coal deposits) are also described. The parameters of borehole underground coal gasification for the Solenovsk coal mine on the model of rock and coal massif are detailed too. The method of in situ gasifier preparation, and the sequence of coal seam gasification during a standard installation are also described in detail. Interpretations based on the conducted research and investigation are also presented.

Keywords
borehole underground coal gasification, in situ gasifier, rock mass, combustion face, chemical balance

1. INTRODUCTION

The technology of borehole underground coal gasification (BUCG) allows us to describe the generation of electric and thermal energy, passing chemical products, fuel and fluid gases in the locations of coal seams. The installation of this technology will ensure obtaining the capability to explore uneconomical coal reserves and local deposits of solid fuel in difficult geological conditions.

As compared to traditional mining, during BUCG it is possible to reduce the miners' labour, and to use uneconomical and unconditional coal reserves. The products of gas combustion do not contain the oxides of carbon and sulfurous anhydrite.

The methods, technological implementations and the construction of in situ gasifiers designed in the National Mining University allow us to manage the process of underground coal gasification by keeping the thermo-chemical balance of conversions and the physical processes of coal seam gasification. Enterprises using BUCG technology enjoy the automation of production processes. The final product of such processes does not become coal, rather it is an element for further conversion, such as, kilowatts of thermal, electric energy and chemical row materials.

2. DETERMING COAL SEAM SUITABILITY FOR UNDERGROUND COAL GASIFICATION

The criteria for coal seam suitability for BUCG are the results of gathered information concerning geological, technical and hydrogeological specifics. Based on the evaluation of practical materials of coal seam gasification at the Pidzemgaz stations (Lisichanska, Gorlovska and Yuzhno-Abinska), investigations conducted on an experimental mine gasifier and stand unit options, the generalized dependences of criteria for 12 areas of the Solenovsk coal deposits were found. To carry out the industrial experiment, area No 1 was chosen (Antonov, Kazak, Kapralov 1988).

Area No 1 is located in the field of the Solenovsk coal deposits – 1, 2, 3, Krasnoarmiyskogo coal district, Donetsk. It joins the north-eastern bend of the Ukrainian crystalline rockmass and extends along on the southeast beads of the Donetsk ridge.

To the down-dip and to the rise, the series of strata are limited by the Shevchenkivskiy fault No 1 and the Kirillovskiy fault, along the strike – the Shevchenkivskiy fault No 3. The size of the area to down-dip H = 1410 m, on the rise southward S = 827 m, on the north S = 3000 m. General productive coal reserves are Z = 4786.8 thousand tons. The stratification depth of coal seams H = 72–221 m, thickness – 0.5–0.9 m, angle of inclination a = 10–19°.

The criteria of strata formation suitability located in area No 1 for underground coal gasification is covered by basal factors: mining and geological, hydrogeological and technical. The scope of the area indicates the presence of natural screens (disjunctive dislocations) (Gukov et al. 2012). The stratification depth of coal seams facilitates efficiency and fail-safe working. Hard coal seams are within the limits of 0.7–0.9 m, this is deemed to be lower in the criteria of suitability of coal seams to BUCG. Containing rocks (77.2% clay stone and siltstone) along with penetration capabilities within the limits 0.71–1.06 Darcy, ensures impermeability and the efficiency of processes at the penetration capability of coal seams 0.38–0.62 Darcy.

In these terms the expected inflow of water in the gasifier will be between 1.2–3.4 m^3/t (on a hydrogeological factor this area requires supplementary explorations).

Thanks to current technological and engineering developments, assurances were obtained regarding the effective and fail-safety of coal seam gasification processes in this area.

The criteria of suitability to in situ coal seam gasification in area No 1 is presented in table 1.

2.1. Materially-thermal balance of the coal seam gasification process

For the calculation of the materially-thermal balance of BUCG, the program MTBalanse SPGU was utilized. It was designed by the employees from the Underground Mining Department of the National Mining University (Lavrov 1957; Falshtynskyi 2009). The calculation algorithm includes thermo chemical conversions of solid fuel into gas and condensed fluid in the conditions of elementary composition of coal seams, external water inflow and the thermal balance of the in situ gasifier. A program algorithm is presented in figure 1.

The program for calculating material and thermal balance parameters of BUCG processes takes into consideration the following conditions: changes of anthropogenic situations in rock layers that contain in situ gasifier qualities taking into account mining-geological conditions and technological parameters of the process; the peculiarity of the composition of air blast mixtures and their influence on coal seam gasification processes; the change of qualitative and quantitative indices of BUCG gas with grades of coal seams and air blast mixture; the influence of geometrical parameters of oxidation and the restoration zone of gasifier reactions channeled on the balance of kinetic indices of chemical reactions and physical rates; the influence of coal seam degassing efficiency on thermal balance; the influence of gasification process ballast gases on the qualitative indices of an in situ gasifier; the practicality of the substantiation of balance calculation parameters for the prediction of production indices manageability for the Pidzemgas station.

The technological indexes of the in situ gasifier and the escape of basic chemical products at BUCG are presented in tables 2 and 3, the characteristics of materially-thermal balance in the area for BUCG No 1 are presented in tables 4, 5, 6.

With oxygen blowing in the range O_2 = 45–62% (4186.13 m/h), the capacity of underground gas generation is provided thanks to gas production $68.4 \cdot 10^6$ m^3/h and electrical power 27.4 MWth, with efficiency equal to 80.5% and by the temperature in production borehole, T = 534°C.

Blowing carbon dioxide CO_2 – 379.3–969.4 m^3/h, provides in combination with oxygen (2092.4–4 014.2 m^3/h) and steam (1863.8 m^3/h) the receipt of power gas with high-quality coefficients: the escape of burning gases of 50–80.7·106 m^3/y, electrical power 25.2–27.5 MWth, with efficiency equal to 79.12–80.3% and by the temperature gas in outlet borehole, T = 529°C.

The arrangement of blowing mixture O_2 (2856.8 m^3/h) + steam (2037.1 m^3/h), provides gas $57.1 \cdot 10^6$ m^3/h with N_2 – 23.06%, CH_4 – 22.45 and CO – 11.05%, such an arrangement of burning gases, at oxygen + steam and air + steam blowing (steam = 2218.4 m^3/h, N_2 – 15.13%, CO – 6.31%), permits a technological gas discharge suitable for synthetic gas.

The coefficients of the air blowing provide a power gas discharge with the following coefficients: escape of burning gases, $26.9 \cdot 10^6$ m^3/h, and electrical power, 13.9 MWth, with efficiency equal to 62.9% and by the temperature gas in outlet borehole T = 366°C, at the heat of combustion of power gas 4.71 MJ/m^3.

The pressure in gasifier at the air and air + steam blowing P = 0.24–0.57 MPa, at blowing, enriched O_2; CO_2; H_2O (steam) P = 0.38–1.2 MPa.

Table 1. Basic suitability criteria underground coal gasification of the area №1 (c^1_6; c_6; c^1_5; c_5; c^2_4)

Name of coal seam	Seam thickness m	Coal seam ash content A^C, %	Wall rocks (roof. bottom); total: Thickness of clays or other low-permeable rocks in roof; h^1, м $h^1/m > H_s$	Wall rocks (roof. bottom); total: Thickness of clays or other low-permeable rocks in ground; h^1, м $h^1/m > H_s$	Wall rocks (roof. bottom); total: Distance from low-permeable rocks in roof to aquifer; h^1, м $h^1/m > H_s$	Sulfur content in the seam (analytical state) S, %
c^1_6	0.9	6.9–12	14.3 > 8.1	9.6 > 2	24.5 > 10.8	1.9
c_6	0.7	6.2–18	12.5 > 6.3	7.3 > 2	11.2 > 8.4	1.9
c^1_5	0.75	10–21	13.2 >6.8	5.5 > 2	15.75 > 9.0	1.1
c_5	0.7	5.9–16	10.1 >6.3	6.2 > 2	11.4 >8.4	1.9
c^2_4	0.55	9.2–17	18.4 >5.5	7.8 > 2	22.6 >6.7	2.5

H_s – height of the random caving zone compared to seam thickness, h_s/m.

continuation of **Table 1**

Name of coal seam	Minimal safe mining depth (*H*) and seam dip angle from α = 0° to 45° (wings. mould)	Tectonic dislocation	Specific water inflow. m³/ t into reaction channel of the gasifier considering BUCG process intensity. (not more than 1.6–3.4 m³/t): Q_{air}, t/h	Specific water inflow: Q_{oxygen}, t/h	Moisture content of BUCG gas g/ m³: Q_{air}	Moisture content of BUCG gas g/ m³: Q_{oxygen}	Ratio of coal and rock gas-permeability
c^1_6	69.8 m > 15	Boundaries of the area. Disjunctive dislocation.	4.4	2.8	445	238	21–38
c_6			4.15	2.17	429	234	17–29
c^1_5			4.23	2.25	387	231	18–34
c_5			4.04	2.2	375	220	18–36
c^2_4			3.6	1.98	411	235	20–37

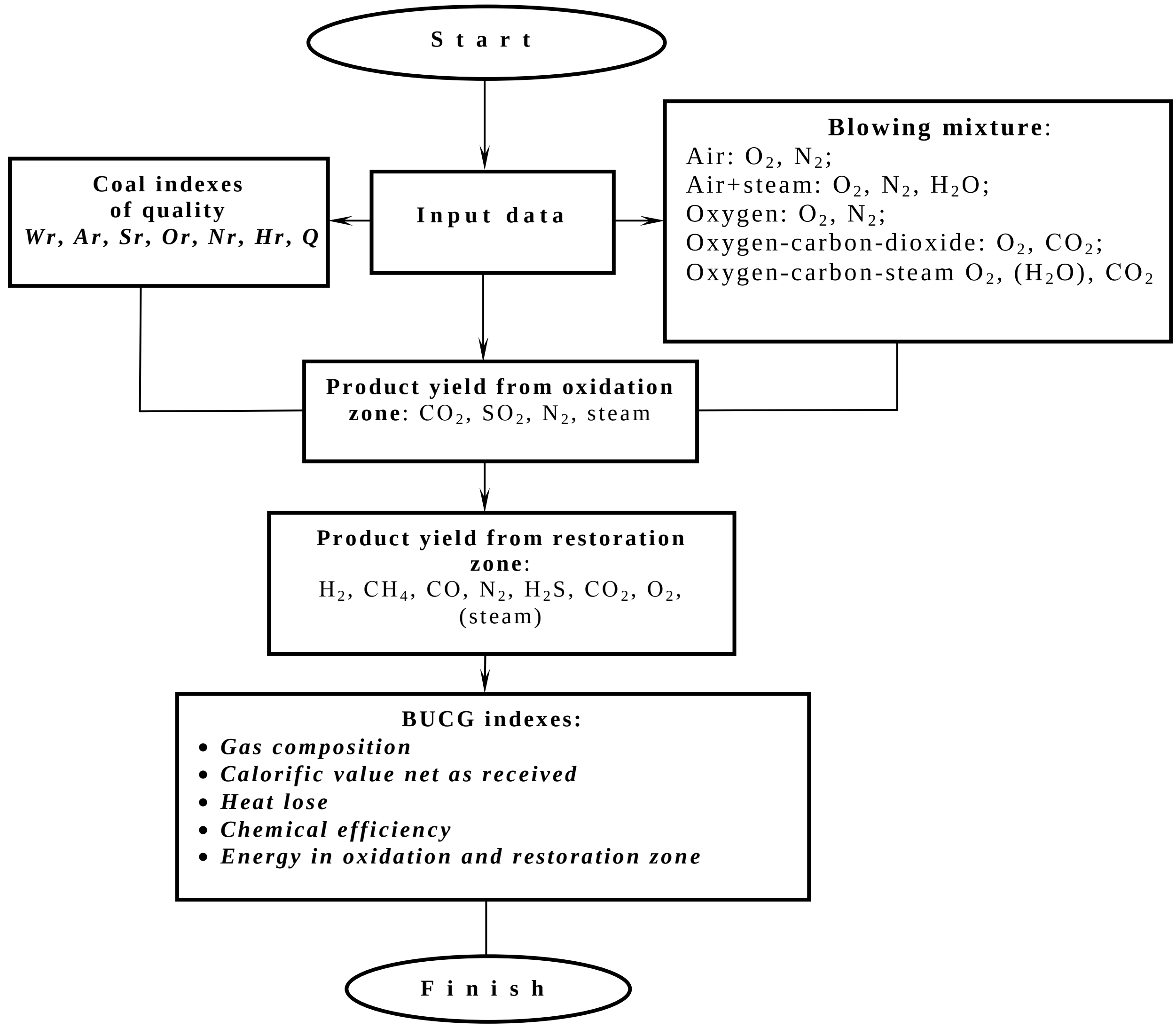

Figure 1. Algorithm of the program for material and thermal balance calculation

Table 2. Technological indexes of in situ gasifier

Indexes of in situ gasifier	Blowing composition					
	Air	Oxygen	Oxygen + CO_2 + steam	Oxygen + CO_2	Air + steam	Oxygen + steam
Thermal power	GKal					
	11.97	23.6	21.7	23.72	14.17	22.1
Electrical power	MWth					
	13.9	27.4	25.2	27.5	16.4	25.6
Capacity on gas (CH_4, CO, H_2)	10^6 m^3					
	26.9	68.4	57	80.7	32.2	57.1

Table 3. Escape of main chemical products during production activities of in situ gasifier

Types of blowing mixture	Escape of chemical products at BUCG (tons)			
	Coal tar	Benzol	Ammonia	Sulphur
O_2N_2	2649	482.4	1050	153.3
H_2O(steam)+O_2 N_2	26207	476	1132.6	164.6
O_2(30–62%) N_2	2829.4	609.4	758.3	286.2
O_2+steam	2624	578.1	782.6	235.3
CO_2+O_2	2858	621	718.4	293.4
CO_2+O_2+H_2O(steam)	2665	588	773	277.2

Table 4. Characteristics of materially-thermal balance (coal seam c_6^1 – 0.9 m)

Type of blowing mixture	Blowing characteristics	Gas quantity from gasifier, %						
	m^3/h	H_2	CH_4	CO	N_2	H_2S	CO_2	O_2
Air	6 957	4.68	4.46	26.13	60.21	0.3	3.68	0.54
Air + steam O_2 N_2 Steam	7 026 1 266.2 3 541.4 2 218.4	15.13	15.07	6.31	52.74	0.49	9.30	0.78
Oxygen + steam O_2 N_2 Steam	6 323 2 856.8 1 429.1 2 037.1	23.06	22.45	11.05	21.61	0.69	19.98	1.16
Oxygen + carbon dioxide + steam O_2 CO_2 steam	6 118 1 963.8 911.6 3 242.5	26.58	25.24	13.83	0.26	0.61	32.34	1.14
Oxygen O_2 N_2	6 885 4 186.1 2 698.9	10.27	9.78	37.31	21.46	0.66	10.26	1.19
Oxygen + carbon dioxide O_2 CO_2 N_2	6 506 4 014.2 969.4 1 522.4	11.68	10.17	52.9	11.73	0.69	11.68	1.15

continuation of **Table 4**

Type of blowing mixture	Speed of coal seam gasification	Coefficient of efficiency	Lower heat of combustion	Gas discharge from gasifier	The humidity of BUCG gas	Quantity of coal gasification
	m/day	%	MJ/m^3	m^3/kg of coal	g/m^3	t/h
Air	1.94	62.87	4.71	2.84	372	2.5
Air + steam O_2, N_2, steam	2.04	68.21	5.82	2.94	473	2.62
Oxygen + steam O_2, N_2, steam	2.63	78.4	8.5	2.12	369	4.25
Oxygen + carbon dioxide + steam O_2, CO_2, steam	2.3	79.12	9.28	2.19	320	4.2
Oxygen O_2, N_2	2.5	80.5	9.84	1.95	238	5.06
Oxygen + carbon dioxide O_2, CO_2, N_2	2.25	80.03	9.36	2.08	274	4.26

Table 5. Technological characteristics of BUCG process (coal seam c_6^1 – 0.9 m)

Type of blowing mixture	Expenditure of blowing				Escape of BUCG gas			
	thousand m^3/h	thousand m^3/d	thousand m^3/m	thousand m^3/y	thousand m^3/h	thousand m^3/d	thousand m^3/m	thousand m^3/y
Air	6.96	167	5 011.2	60 134.4	8.83	212	6 360	76 320
Air + steam	7.03	168.7	5 061	60 732	9.2	221	6 630	79 560
Oxygen	6.88	165.1	4 953.6	59 443	12	288	8 640	103 680
Oxygen steam	6.32	151.2	4 536	54 432	10.5	252	7 560	90 720
Oxygen + carbon dioxide	6.5	156	4 680	56 160	12.5	300	9 000	108 000
Oxygen + carbon dioxide + + steam	6.12	146.9	4 406.4	52 876.8	10.1	242.4	7 272	87 264

continuation of **Table 5**

Type of blowing mixture	Quantity of coal gasify for set time:				Time of gasification days	Quantity of gas at exploitation 10^6 m^3
	t/h	t/d	t/y	kg/for the time of gasifier exploitation		
Air	2.5	60	21 900	15 330	256.6	53.4
Air + steam	2.62	62.88	22 951.2	16 754.4	240.5	59.6
Oxygen	5.06	1214	44 311	13 293.3	105	31.1
Oxygen +steam	4.25	102	37 230	13 075.3	128.5	33.2
Oxygen + carbon dioxide	4.26	102.2	37 303	13 802	135	40
Oxygen + carbon dioxide + + steam	4.2	100.8	66 792	15 452.6	152	36.7

Table 6. Thermal balance of underground coal gasification (coal seam c^1_6 – 0.9 m)

Indexes	Blowing composition											
	Air		Oxygen		O_2+ CO_2+ steam		Oxygen + carbon dioxide		Air + steam		Oxygen +steam	
	MJ/kg	%	MJ/kg	%	MJ/kg	%	MJ/kg	%	MJ/kg	%	MJ/kg	%
Heat of combustion on a working fuel	35.04	97.64	35.04	91.25	35.04	91.25	35.04	91.25	35.04	92.79	35.04	91.25
Entalphy in oxidation zone	0.636	1.772	1.272	3.312	1.272	3.313	1.272	3.312	0.636	1.684	1.272	3.312
Entalphy in blowing	0.208	0.580	2.087	5.434	2.087	5.434	2.087	5.434	2.087	5.526	2.087	5.434
In all:	35.88	100	38.40	100	38.4	100	38.4	100	37.76	100	38.4	100
Heat of gas combustion	13.37	38.32	19.09	49.70	20.12	51.96	19.47	50.83	17.1	44.40	18.02	46.88
Heat lose: Heating of ash and slag, MJ	0.095	0.272	0.095	0.247	0.095	0.245	0.095	0.248	0.095	0.247	0.095	0.247
Warming evaporation of moisture, MJ	0.375	1.074	0.375	0.976	0.375	0.965	0.375	0.979	0.375	0.974	0.375	0.974
Heating of containing rocks (roof. ground), MJ	6.310	18.079	5.562	14.482	5.510	14.23	5.146	13.435	5.915	15.365	5.967	15.5
Entalphy of generator gas	14.74	42.25	13.28	34.59	12.62	32.6	13.21	34.5	15.01	39.0	14.0	36.39
In all:	34.903	100	38407	100	38.724	100	38.304	100	38.495	100	38.497	100
Outlet tempe-rature in gas-generator, °C	522		803		798		767		652		705	
Outlet tempe-rature in production borehole, °C	346		441		436		421		360		378	

3. EXPERIMENTAL INVESTIGATION OF THE TECHNOLOGICAL PROCESSES OF BUCG AT A THIN COAL SEAM

As a result of an experimental investigation, the information concerning the heating parameters around a gasifier, the composition of the generator gas, the ignition parameters and the reactionary channel burning in the combined gasification mode were obtained and are presented in table 7, figure 2.

Table 7. Generator gas composition during the experimental investigation

Type of blowing	Time	Gas composition							Heating value MJ
		CH_4	CO	H_2	CH_4+CO+H_2	CO_2	N_2	O_2	
Ignition	12:00	0.00	0.00	0.00	0.00	0.97	78.08	20.95	0.00
	12:30	0.12	0.08	0.00	0.02	1.85	77.80	20.15	0.00
	13:00	0.64	0.82	0.45	1.91	1.84	76.30	19.95	0.38
	13:30	0.75	1.25	0.86	2.86	4.14	77.20	15.80	0.52
	14:00	0.98	1.60	1.15	3.73	6.67	77.30	12.30	0.68
	14:30	1.37	2.87	1.84	6.08	9.08	76.90	7.94	1.06
	15:00	1.40	3.23	2.12	6.75	10.51	77.12	5.62	1.14
	15:30	1.46	3.56	2.20	7.22	11.48	77.03	4.27	1.22
Air blowing	16:00	1.58	3.83	2.33	7.75	11.40	76.98	3.87	1.31
	16:30	2.36	5.65	4.72	12.73	8.53	76.50	2.24	2.08
	17:00	3.45	6.18	5.23	14.86	6.62	76.50	2.02	2.59
Blowing. Enriched with O_2 – 25% post-reversing mode	17:30	4.83	8.88	6.17	19.88	3.25	74.43	2.44	3.54
	18:00	5.02	8.46	7.96	21.44	1.02	74.25	3.29	3.74
	18:30	5.05	8.14	8.58	21.77	0.91	74.19	3.13	3.78
Blowing. Enriched with O_2 – 30% and steam – 20%	19:00	5.13	7.38	10.58	23.08	0.54	73.16	3.22	3.93
	19:30	6.50	6.43	10.12	23.05	0.90	72.94	3.11	4.25
	20:00	6.87	5.75	9.85	22.47	1.27	73.40	2.86	4.27
Blowing. Enriched with O_2 – 27% and steam – 15%	20:30	7.17	4.92	9.46	21.54	1.01	74.12	3.33	4.23
	21:00	6.40	5.35	7.35	19.10	2.32	74.21	4.37	3.78
	21:30	5.25	6.89	6.80	18.94	2.45	74.33	4.28	3.50
Blowing. Enriched with O_2 – 25% and steam – 12% (impulsive mode)	22:00	4.08	7.29	5.33	16.71	3.07	75.87	4.35	2.97
	22:30	3.25	6.56	5.12	14.93	5.68	75.19	4.20	2.56
	23:00	2.78	6.10	5.02	13.90	6.70	75.25	4.15	2.32
Steam-air blowing O_2 – 21% and steam – 10% (impulsive mode)	23:30	1.21	4.25	4.21	9.67	9.51	76.23	4.59	1.43
	0:00	1.18	4.14	3.82	9.14	9.73	76.79	4.34	1.36
	0:30	0.86	3.12	2.75	6.73	11.71	77.15	4.41	1.00

Figure 2. Gasification channel ignition with temperature fix: a – thermocouples above combustion face in the stationary mode, b – ignition stage and combustion face burning, c – gas analyzer Gasboard-3200L and BX-170, d – pyrometer in the dynamic mode

In table 7, the generator gas composition, on the base of which heat value, is calculated by the following equation is shown:

$$Q = \frac{285640\mathrm{CO} + 241800\mathrm{H}_2 \cdot 805564\mathrm{CH}_4}{22.4}, \mathrm{MJ/m}^3$$

where CO, H_2, CH_4 = percent correlation in generator gas.

The heat value of generated gas during the experiment was 2.2 MJ with the maximum indicator of 4.27 MJ on the 8^{th} h of the experiment, and taking into account the factor of similarity 2.4 these indicators make 5.32 MJ and 10.24 MJ.

Temperatures was controlled due to the temperature--sensitive elements which were fixed in the TERA "Devices Systems" Firebird 2.1 database. The screenshot of a program data archive of temperatures is represented on figure 3.

The temperature balance and combustible gases outlet depending on the different blowing components during the time on the stand setting is shown in figure 4.

Analyzing the experimental results we can say that at a distance of 0.4 m (1.6 m in the model) from the gasified seam, roof rocks are exposed to convection heat exchange and warming-up of gaseous BUCG products due to their migration through cracks and exfoliations above coal massif (Falshtynskyi et al. 2012a). The intensity of the warming-up of roof falls at the reducing expense of the sizes of breaking rock layers, the conditions of conductive heat exchange is observed.

At a pressure of 0.25 MPa in the above coal seam of the stand, fistulas from gaseous BUCG products were observed. It occurred at 10:30 p.m. With goaf increase, gas and blowing losses also increased, the quality indicators of generative gas worsened.

The distribution of temperatures on the length of the reactionary channel is connected with the length of the channel, its section, the quantitative and qualitative structure of the blowing mixture and received gases, the extent of deformations and the temperature indicators of rocks. Rocks of roof subsidence above the gasifier were fixed by the Monitor QB program.

Differences between general results following investigation make up 1–8 marks. The curves characterizing the rocks of roof subsidence are presented in figure 5.

As we can see from the subsidence schedule, the roof rocks lowered by a maximum of 8 sm, this is connected with the ordered lowering on an ash residue (17–22% from the thickness of the gasified coal seam) and rocks swelling above the combustion face with a factor of swelling being $K_{sw} = 1.4$.

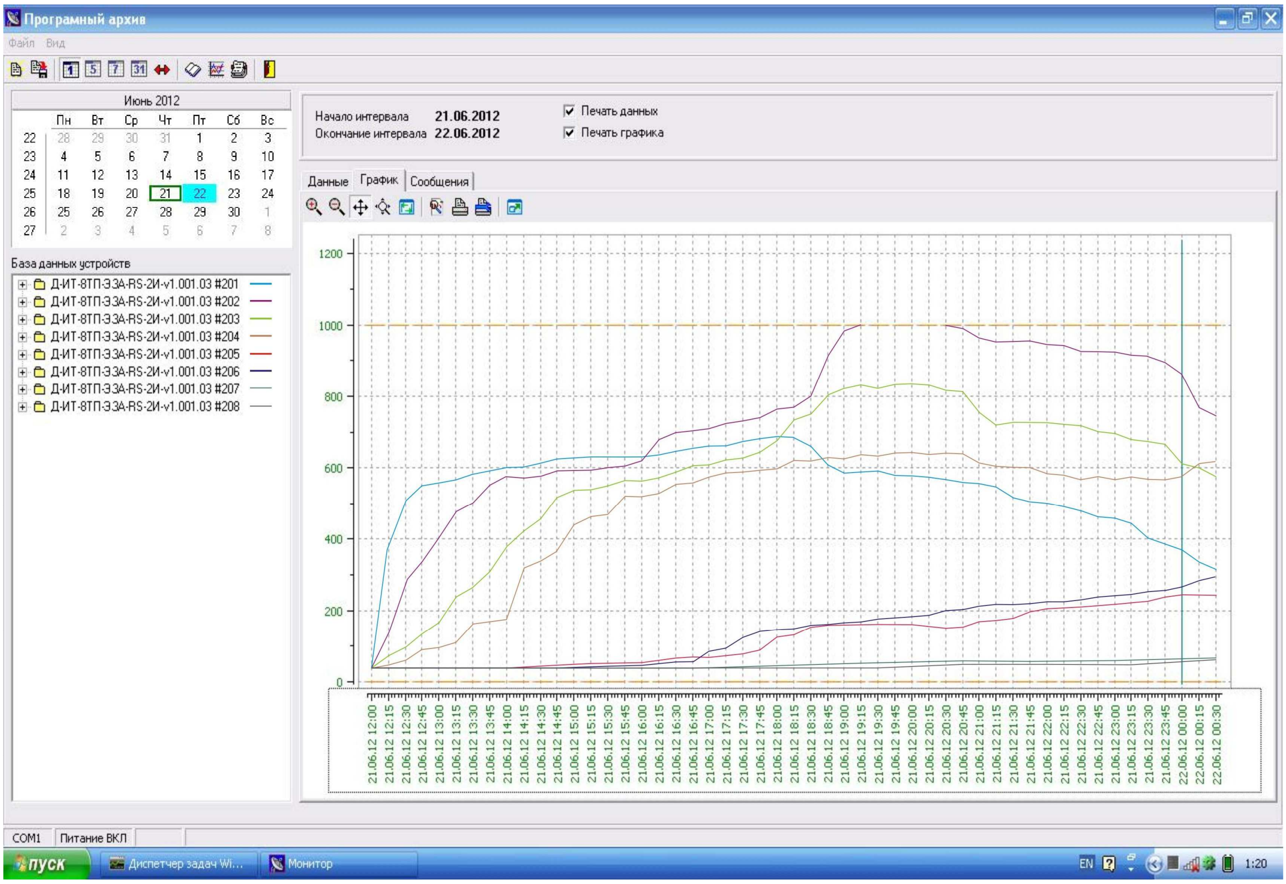

Figure 3. Screenshot of a temperatures program archive database

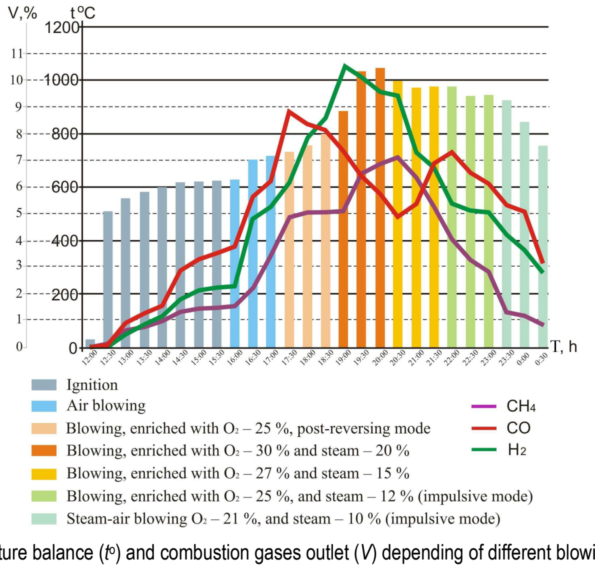

Figure 4. Temperature balance (t^o) and combustion gases outlet (V) depending of different blowing mixture in a time

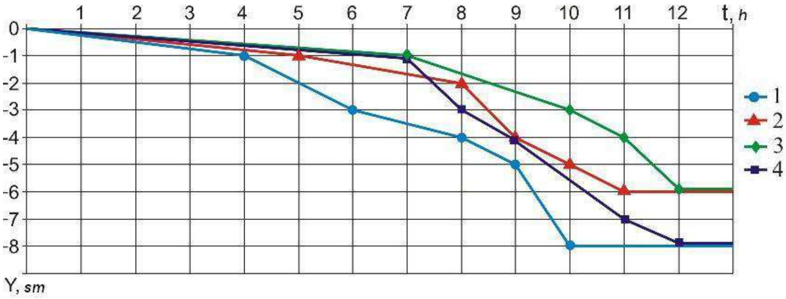

Figure 5. Rocks of roof subsidence in the process of goaf formation

4. TECHNOLOGICAL SCHEME AND ORDER OF IN SITU GASIFIER PREPARATION

Gasifier preparation is carried out from the surface. The order of the gasification of coal seam descends, as can be observed in Figure 6. For assuring the efficiency of the gasification process in area No 1, the construction of an in situ gasifier (Figure 7) is used with long coal walls. The system of gasification by long columns to up-dip L = 400 m. The distance between the boreholes, l = 30 m.

Preparation of the gasifier is ensured thanks to in-seam directional drilling.

Coal seam ignition is provided through the directional boreholes by binary explosives (Falshtynskyi et al. 2011). Ignitions of coal thanks to the application of this method and the possibly of the presence of water does not require drilling of ignition boreholes.

Control of the blowing mixture direction is carried out by a flexible pipeline, as in Figure 7. The selective discharge of the blowing mixture will provide the interference of blowing with the fire combustion face. For intensification of the process, the six arrangements of the blowing mixture and heating of the blowing are foreseen before a discharge in a gasifier to 200°C, and also the impulsive discharge of the main chemical agents (oxygen, steam, carbon dioxide) is provided on the combustion face with different time duration. With the purpose of equal combustion, face advancing in the reverse direction of gasification is foreseen.

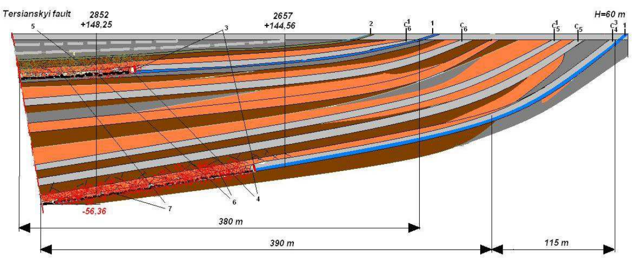

Figure 6. Technological scheme of coal seams on area No 1: 1 – inlet borehole, 2 – stowing borehole, 3 – combustion face, 4 – a reaction channel of in situ gasifier, 5 – a stowing rock mass, 6 – goaf, 7 – ash and slag

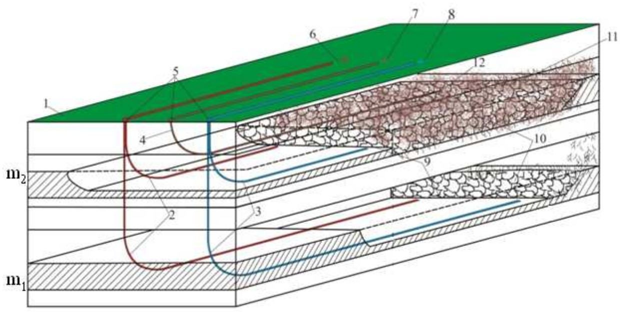

Figure 7. Technological scheme of borehole underground coal gasification: 1 – surface, 2 – outlet borehole, 3 – inlet borehole, 4 – stowing borehole, 5 – inlet borehole direction, 6 – direction of gaseous products, 7 – direction of stowing material, 8 – direction of blowing mixture, 9 – gasification channel (30 m), 10 – goaf, 11 – stowing massif, 12 – control retraction point (0.4 m)

For gasification channel preparation it is necessary to connect between the blowing (ignition) and production boreholes. For their connection it is also possible to form the gasification channel between operating boreholes by directional drilling. The drilling technology of the gasification channel is analogical to the drilling operating boreholes. The horizontal part (blowing) of the ignition borehole must be oriented across the horizontal parts of the production borehole with a subsequent turn in the direction of each other (Gukov et al. 2011). For gasifier preparation, drilling a 2nd borehole is recommended.

5. CONCLUSIONS

The efficiency of BUCG related to the seasonal expenditure of products, must be obtained using BUCG products. This entails the receipt of chemical products from condensed fluid, the use the generator gas for the receipt of chemical agents by thermal conversion, and also thermal and generator gas for electric energy for power installations.

The heat recuperation from rocks containing a gasifier and BUCG products is provided by recuperation collections (Falshtynskyi 2009; Falshtynskyi et al. 2012b) for the receipt of electric power. The remaining heat is utilized for engineering (heating of blowing, process of catalytic conversion) and domestic needs.

Chemical raw materials, obtained from the condensed fluid of power gas of underground gasification can be released (coal tar, benzene, ammoniac water, phenols, acetylene, pyridines et.c.) or processed later (grey, surface active agents, solvents, carbon, dyes, polymer cements, naphthalene et.c.).

The utilization of smoke from power stations is based on the principle of the closed cycle. Combustion gases like CO_2 act from a power station back in an in situ gasifier, where it co-operates with a burning hot carbon pass to burn gas – monoxide of carbon (CO) and oxygen of O_2. Adding CO_2 to blowing gas will not yield conventional gas. In an in situ gasifier, direct oxides SOn and nitrogen NO_n and other toxic components of smoke can escape from a power station.

Stowing material can be used of off cuts from a coal power station. This will provide safety for the landscape, fail-safes and ensure the efficiency of the gasification process (Falshtynskyi 2009; Kolokolov et al. 2000).

At the building and production areas of activity, with a gasifier at the BUCG area, the investigations are understood as an audit of engineer decisions and the technological characteristics of rock mass behavior during gasification. Varying the parameters of gasification processes with the purpose of receiving the complex-industrial product of gasification from a coal seam.

Noncombustible mineral particles at coal gasification and carboniferous rocks remain in the goaf, because they are not exposed to thermal decomposition. Sufficient impermeability of the in situ gasifier is ensured by injecting the stowed deformed rocks containing a gasifier and goaf.

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