

THE MOST EFFECTIVE DEGASING METHODS WHEN CARRYING OUT PREPARATORY COAL MININGS

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The article presents the most effective degassing methods when carrying out preparatory workings for coal, provides an analysis of the effectiveness of each degassing method, the conditions for their use to reduce the gas content of the formation, increase the pace of preparatory workings and the safety of mining operations. To reduce the gas content of workings carried out in a coal seam, preliminary degassing of the seam can be used, carried out before the working, or degassing of the coal mass during the working period. The most effective way to reduce methane emission into development workings is preliminary degassing of the coal mass with a period of gas capture before the start of tunneling work in the prepared area of at least 12 months.

Keywords: coal, degassing, hydraulic fracturing, methane, development workings.

КӨМІРГЕ ДАЙЫНДЫҚ ЖҰМЫСТАРЫН ЖҮРГІЗУ КЕЗІНДЕ ГАЗСЫЗДАНДЫРУДЫҢ ЕҢ ТИІМДІ ӘДІСТЕРІ

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Мақалада көмірге дайындық қазбаларын жүргізу кезінде газсыздандырудың ең тиімді әдістері келтірілген, газсыздандырудың әр әдісінің тиімділігіне талдау жасалады, қабаттың газдылығын төмендету, дайындық қазбаларын жүргізу қарқынын арттыру және тау-кен жұмыстарын жүргізу қауіпсіздігі үшін оларды қолдану шарттары келтірілген. Көмір қабаты бойынша жүргізілетін қазбалардың газдың көптігін төмендету үшін қазба жүргізілгенге дейін жүзеге асырылатын қабаттың алдын ала газсыздандырылуы немесе қазба жүргізу кезеңінде көмір массивінің газсыздандырылуы қолданылуы мүмкін. Дайындық қазбаларына метан бөлуді азайтудың ең тиімді әдісі-дайындалған учаскеде қазу жұмыстары басталғанға дейін газды қаптаждау мерзімі кемінде 12 ай болатын көмір массивін алдын ала газсыздандыру.

Түйінді сөздер: көмір, газсыздандыру, фрекинг, метан, дайындық қазбалары.

НАИБОЛЕЕ ЭФФЕКТИВНЫЕ МЕТОДЫ ДЕГАЗАЦИИ ПРИ ПРОВЕДЕНИИ ПОДГОТОВИТЕЛЬНЫХ ВЫРАБОТОК ПО УГЛЮ

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В статье приведены наиболее эффективные методы дегазации при проведении подготовительных выработок по углю, дан анализ эффективности каждого метода дегазации, условия для их применения для снижения газоносности пласта, повышения темпа проведения подготовительных выработок и безопасности ведения горных работ. Для снижения газообильности выработок, проводимых по угольному пласту, может

применяться предварительная дегазация пласта, осуществляемая до проведения выработки, или дегазация угольного массива в период проведения выработки. Наиболее эффективным способом снижения метановыделения в подготовительные выработки является предварительная дегазация угольного массива со сроком каптажа газа до начала проходческих работ на подготавливаемом участке не менее 12 месяцев.

Ключевые слова: уголь, дегазация, гидроразрыв, метан, подготовительные выработки.

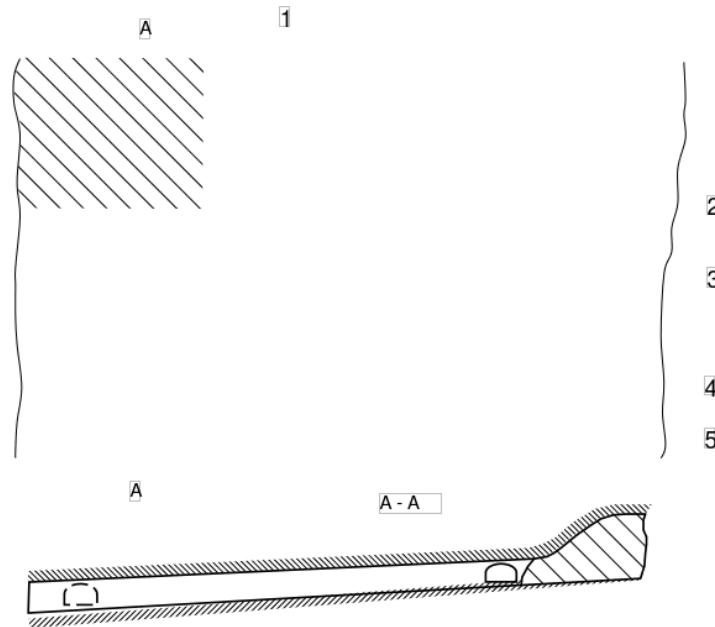
Introduction. To reduce the gas content of workings carried out in a coal seam, preliminary degassing of the seam can be used, carried out before the working, or degassing of the coal mass during the working period [1-2].

When designing, the need to use degassing measures is determined based on an assessment of the expected gas release by sources of methane and ventilation capabilities for a particular mining facility. For preparatory workings carried out on coal, the need to use degassing measures is also determined by the degree of danger of the formation due to sudden emissions of coal and gas. One of the conditions for the effectiveness of high-performance mining equipment is preliminary and ongoing preparation for the mining of coal seams, with one of the main activities being degassing of coal seams [3].

Preliminary degassing is carried out by drilling wells through a layer of previously excavated workings and

its efficiency is quite low - in the range of 10-20%, which becomes less as the depth of mining increases. The degassing period must be at least 1-2 years to achieve an acceptable degree of degassing.

Methods and materials. Schemes and methods of degassing for workings (preliminary degassing of the formation, degassing of under- and overworked satellite layers and degassing of the mined-out space) and preparatory faces (preliminary degassing of the formation, degassing of barrier wells during drilling, degassing of bends and boreholes) are selected based on gas abundance site (working) and degassing efficiency [4]. First of all, degassing measures are applied at the source with the greatest gas release. In the event that it is not possible to reduce the methane content in the mine atmosphere to an acceptable standard using one method, complex degassing is used, that is, a combination of methods or schemes for degassing one or more sources of methane release.



1 - lava; 2 - conveyor drift of active longwall; 3 - gas pipeline; 4 - downwells; 5 - conveyor road for future longwall

Figure 1 - Scheme of degassing of a flat formation using downwells

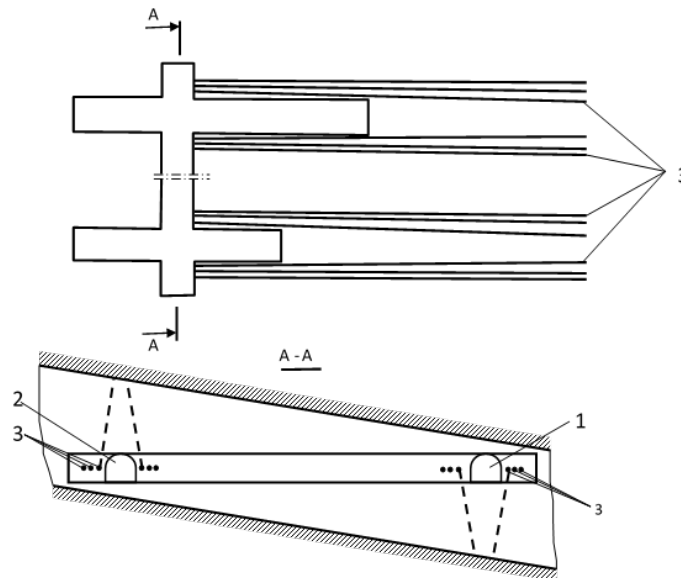
Results and discussion. The most effective way to reduce methane emission into development workings is preliminary degassing of the coal mass with a period of gas capture before the start of tunneling work in the prepared area of at least 6 and 12 months, respectively, for rising (horizontal) and descending wells drilled 10 m beyond the contour of future development workings in according to Figure 1.

In cases where it is not possible to carry out preliminary degassing of the coal mass, barrier wells are

drilled during mining in accordance with Figure 2.

Barrier wells located at a distance of 150-200 m from the working face can be disconnected from the degassing network and plugged if they do not affect the gas content of the working.

Barrier wells are drilled from chambers. The length of the wells is assumed to be 100 - 150 m. The distance between the chambers is 15 - 20 m less than the length of the wells, the wellheads are located at a distance of 1.5 - 2.5 m from the excavation wall [5].



1 - workings along the upper layer of the formation; 2 - workings along the lower layer of the formation; 3 - barrier wells

Figure 2 - Scheme of degassing during development workings using barrier wells

When carrying out preparatory excavation along the upper or lower layers of thick layers, one well on each side is drilled into the soil or into the roof of the excavation. The distance between the faces of these wells is assumed to be 2 m. Wells drilled on the sides of the workings are located parallel to its axis.

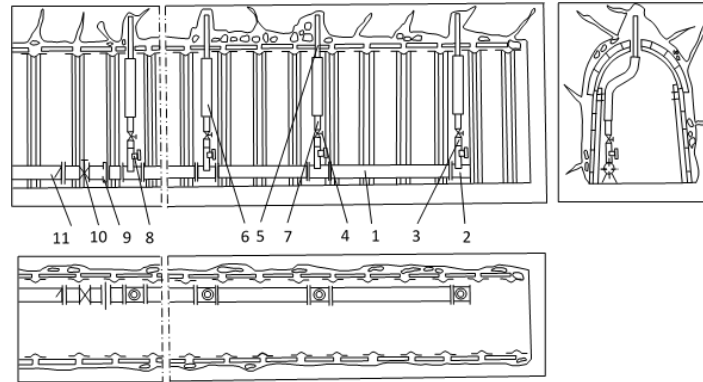
When carrying out paired workings, barrier wells should be drilled for each working. If paired workings are carried out alternately ahead of one of the working faces, and the width of the pillar between workings does not exceed 15 m, then drilling of barrier wells on both sides of the working is carried out only for the leading working face, and for workings carried out with a lag, drilling of wells in the side wall on the side An inter-track pillar is not necessary [6-7].

Wells or boreholes are drilled at an angle of 30° to the axis of the excavation so that their faces are at a distance of up to 5-6 m from the walls of the excavation. Wells (boreholes) are located every 5-10 m along the length of the excavation with a lag from its bottom of no more than 5 m. The sealing length of the borehole mouths is at least 1.5 - 2.0 m.

When working near geological disturbances or when crossing the latter, wells are drilled from chambers 30 m in advance before approaching the disturbance. The wells cross the zone of geological disturbance and are located at a distance of no more than 4 m from the future excavation contour.

If the use of design methods does not provide the required level of gas abundance reduction, an isolated

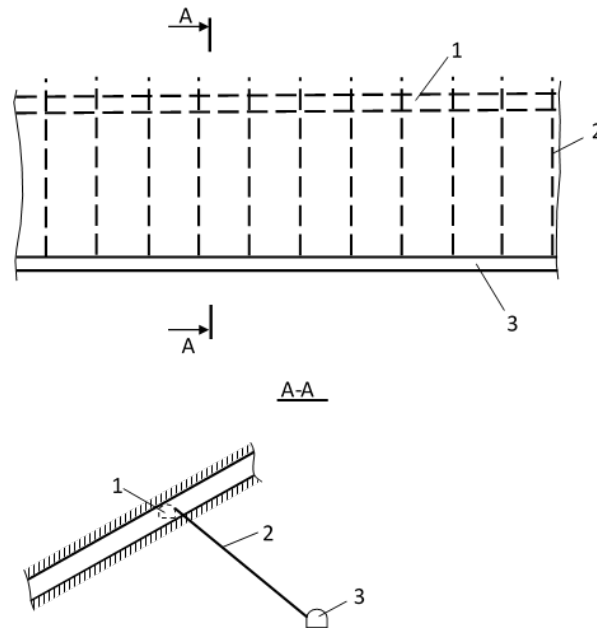
methane outlet can be used as an additional method in outlet pipes to an existing gas pipeline. accordance with Figure 3 with the connection of gas



1 - gas pipeline; 2 - tee; 3 - adapter; 4 - valve; 5 - tube; 6 - rubber hose; 7 - gas suction tube; 8 - fitting; 9 - measuring diaphragm; 10 - valve; 11 - check valve

Figure 3 - Scheme of isolated methane removal

During field preparation of coal seams, degassing of the coal massif in the area of future development workings is carried out using wells drilled from field workings according to the scheme in accordance with Figure 4.



1 - seam development working; 2 - degassing well; 3 - field road.

Figure 4 - Scheme of formation degassing by wells, drilled from field workings

The possible efficiency of degassing when excavating in coal seams is shown in Table 1.

Degassing underground wells into underworked and

overworked layers, above collapse domes, and vertical wells from the surface are drilled in such a way that they ensure the most efficient and long-lasting operation [8].

Table 1 - Efficiency of degassing when excavating in gas-bearing formations

Degassing method	Maximum achievable coefficient degassing	Maximum magnitude rarefaction	
		kPa	mmHg
Preliminary degassing of the coal massif	0,2	2,66	20,0
Degassing with barrier wells	0,1	6,7	50
Degassing with blast holes	0,1	4,0	30
Isolated methane outlet	0,1	1,3	10
Degassing with wells from field workings	0,6	2,66	20,0

Calculation of parameters for preliminary degassing of wells drilled beyond the contour of the future development workings is carried out in the following sequence.

The required degassing coefficient is determined by the formula (1):

$$K_n = 1 - \frac{T_n}{I_n} \quad (1)$$

where I_n - the possible value of methane content of the preparatory workings with the adopted means of ventilation, m^3/min , (2);

$$I'_n = 0,01Q_n(c - c_0) \quad (2)$$

where Q_n - the amount of air supplied to ventilate the preparatory workings, m^3/min ;

c - permissible methane content in the outgoing exhaust stream, %

c_0 - methane concentration in the incoming stream, %

I_n - predicted methane production, m^3/min .

If the degassing coefficient is lower than required, then change the parameters of the preliminary degassing wells or provide for increasing its efficiency by, for example, using hydraulic fracturing [9].

To intensify the process of preliminary degassing of the developed formation, its hydraulic fracturing from underground workings can be used using two types of high-pressure pumping units with a capacity of 30-40 m^3/h and 2-3 m^3/h . When using a pump with a capacity of 30-40 m^3/h , underground hydraulic fracturing wells

are drilled from field workings or along the developed formation [10].

In the case when the excavation is carried out with the undermining of the soil of the formation, it is advisable to drill hydraulic fracturing wells into the formation in such a way that the wellhead is located in the soil rocks.

Conclusions. The bottoms of wells drilled for hydraulic fracturing from field workings should be located in the middle part of the degassed area, counting along the length of the longwall. When drilling wells along the formation, their length is 30-40 m less than the length of the longwall if degassing is carried out only for the workings, and 10-20 m less than the length of the longwall if degassing is carried out for both the workings and the development workings. The distance between hydraulic fracturing wells is determined empirically (usually 70-90 m). Sealing length 30-40 m.

Hydraulic fracturing is stopped after the calculated volume of liquid is injected into the formation or water appears in neighboring wells (adjacent workings), as well as when there is a sharp drop in pressure at the pump.

To determine the effectiveness of hydraulic fracturing, the methane flow rate from wells is determined before and after water injection. After hydraulic fracturing, reservoir degassing wells are drilled.

For effective degassing, it is necessary to use a complex of various methods for degassing a coal seam; reducing the gas content of the seam will increase the pace of development work and the safety of mining operations.

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