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THE MODERNIZATION OF WAYS OF TREATMENT OF COAL STRATUMS FOR RISE OF SAFETY OF UNDERGROUND MINE WORK

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Annotation. *The problem of development of theory and technology of treatment of coal stratums in order to raise of security of underground coal extraction is considered. The using of two-phases pneumatic and hydraulic treatment as a way of reduction of gas and dust extraction is proposed.*

СОВЕРШЕНСТВОВАНИЕ СПОСОБОВ ОБРАБОТКИ УГОЛЬНЫХ ПЛАСТОВ ДЛЯ ПОВЫШЕНИЯ БЕЗОПАСНОСТИ ПОДЗЕМНЫХ ГОРНЫХ РАБОТ

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Аннотация. *Рассматривается задача развития теории и технологии обработки угольных пластов с целью повышения безопасности подземной добычи угля. Предложено использование двухэтапной пневматической и гидравлической обработки как средства снижения газовыделения и пылеобразования.*

On the classification of academician A.A. Skochinsky [1], the main hazards in underground coal mining are outgassing, dust, sudden coal and gas emissions, endogenous fires. The complex of methods of solving tasks of control of major hazards in underground coal mining processes occupy a very important place of exposure to coal seams that allow you to change their status and thereby reduce the intensity of dangerous and harmful properties.

In the suggested article describes the approach to reduce dust and gas emissions through integrated hydropneumatic exposures than is determined by the relevance of the work.

The aim of this work is the development of theoretical bases of processes and support integrated mode hydropneumatic effects on anisotropic coal seams.

Currently, there are a number of ways of hydraulic impact on coal seams, which differ both in purpose and in running operations, they are compulsory and regulated by normative documents [2]. For the relevant process the methods of calculation of parameters are designed [3].

All parameters of hydraulic impact can be divided into two groups: the layout parameters and parameters of the pumping. Parameters, belong to the first group: length, diameter and depth of the hermetic part of drill-holes, well spacing or the effective radius, for short is the irreducible wells, lead to long-distance from the treatment plant to scarification first well. The second group includes: liquid consumption on the well, pressure, temp and time.

Look at the schema and settings on a local, regional, and opening the way to discharge coal seams.

Location scheme short (up to 25 m) drill-holes, perpendicular bisector of the line of control, the slaughter is shown in Fig. 1a. The length of the boreholes is usually selected a multiple week moving slaughter. This allows for testing of, at first, position the filter part of the limit of drill-holes reference zone pressure and increase the uniformity of treatment, and secondly, significantly reduced compared with the howling of the short-holes schema dependency injection works from sewage treatment works.

Hydraulic impact on coal seam in the reservoir through a preparatory drill-holes, located on one of the schemas shown in Fig. 1b,c. The length when using both charging boreholes as anti-coal-out recommended within 8-11 m [2], with the suppression of dust – 30-80 m [2]. Feature diagram (Fig. 1b) is imposing zones of influence of wells due to the limited size of the preparatory slaughter mean.

Basic layout of long wells, parallel shall slaughter, are shown in the fig. 2. The scheme shown in Fig. 2b applies if it is not possible to drill wells in one working-out as the full length of the lava. When hollow-steep reservoir excavating pillars on the dip long wells are drilled on the nozzle at right angles to the uprising of the slaughter equipment.

The main disadvantage of long wells, limiting their diffusion used nowadays, is the difficulty of drilling and hermetic sealing due to lack of reliable equipment. In addition, the use of long wells is possible only when sufficient lead preparator of workings, i.e. almost in-pillar development systems.

If you cannot provide simultaneous operation of three wells are recommended to use the technology of continuous cascade process, which consists in the following.

Pressure is one of the three wells temporarily, one of them located on the part of the treated area is supplementary and is used to create a flowing counter drain fluid in this area from the remaining two wells (injection). After working for you at discharge wells for half the estimated time delivery helper hole is minor, and is adjacent to fuel the next hole plugs. Thus resulting in a group of three wells again one is supporting two-pressure, and the process is repeated. Rate of fluid in injection wells must correspond to the natural conditions of injection of reservoir in pursuit of achieving the required flow. A secondary wellbore pressure enough to maintain an approximately equal pressure on the next delivery.

The use of such technology is largely preventing the outflow of fluid turns the predominant part of the extreme wells with water in between larger areas or under intense interaction flows.

Application of cascade processing (Fig. 3) allows, according to a simulation of the modeling and natural experiments, reduce the area of rough areas on the 50%-80% depending on the technological scheme -2 in 1.5 times and reduce the saturation intensity variation of liquid array on the effects of the injection with the same rate of liquid reduces the values of these indicators, respectively, at 35-60% and 25-30% compared to the outflow of the unregulated temp [3].

The local way.

When a discharge in the preparatory slaughter geometric parameters to show in Fig. 1b,c, the effective radius is chosen from the processing conditions for zone 4-metre contour.

The length of the wells drilled from a treatment plant slaughter, usually made of lava moving is a multiple of the week, but not more than 25 m, diameter 60 mm 45-wells. The minimum lead time for short wells was adopted the length of filtration compartment.

Calculation of process parameters is performed according to [3].

A regional way.

Wells are drilled with a diameter of 75-100 mm depending on the use of the equipment used. The length of the wells located on the scheme of Fig. 1a:

$l_c = L_Л - 20$,m; on the scheme of Fig. 1b: $l_c = \frac{L_Л}{2} - 20$ m, where $L_Л$-length of lava, m.

Seal depth is usually 10-20 m.

Calculation of rate and time of discharge is made assuming the angular motion of the one-dimensional nature of the liquid from the wells.

Discharge time:

$$T_H = \frac{53Qm\mu}{l_Ф k_x (P_H - P_Г)}(0{,}13Q+1)\left(\frac{6{,}6}{m^2}+1\right)\left(\frac{4{,}5\cdot 10^{-3}}{n_Э}+1\right)\left(1{,}7\sqrt{A+1}\right), \text{ h}$$

Calculation of parameters in cascade hydraulic action.

Discharge time of liquid in every blow injection well (group wells):

$$T_H = \frac{70Qm\mu}{l_Ф k_x (P_H - P_Г)}(0{,}13Q+1)\left(\frac{6{,}6}{m^2}+1\right)\left(\frac{4{,}5\cdot 10^{-3}}{n_Э}+1\right)\left(1{,}7\sqrt{A+1}\right), \text{ h.}$$

Thus, the hydraulic impact is a normative activity with sufficiently advanced theory and technology.

Studies on the development of ways of dealing with methane in Moscow Mine University mountain is the idea of forcing air into the coal seam in filter mode through wells drilled from the mountain (pneumatical action) with the aim of increasing coal degasification of the array. Mechanism of natural gas the reservoir reducing the discharge air is to output of free methane in air flow ending well, resulting in displacement of the sorption equilibrium in the system of "free-sorption gas" and methane desorption and release it. Technological scheme pneumatic action is shown in Fig. 4.

The simulation results show that the maximum efficiency to reduce gas content is achieved by cyclic pneumatic action with the lowest possible discharge pressures.

When cyclic pneumatic action and P_H = 2.0 MPa methane volume 35-40% higher than for degassing. In this case the duration of discharge cycles was 1-2 days, spontaneous end – 3-4 days.

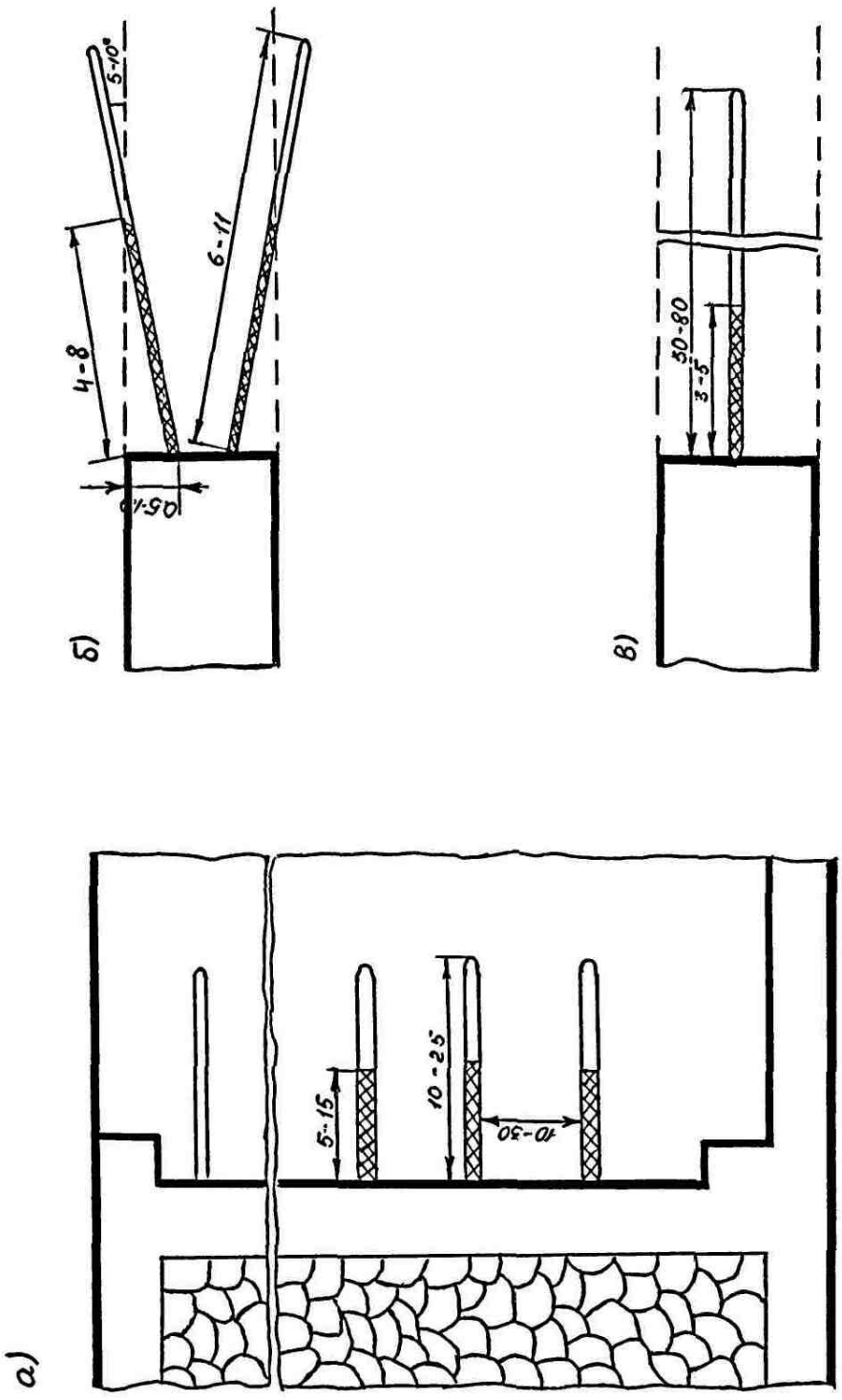


Fig. 1: borehole locations

a - short in the sewage hole;

b (*б*) - short in preparatory design;

c (*в*) - longest is preparatory design.

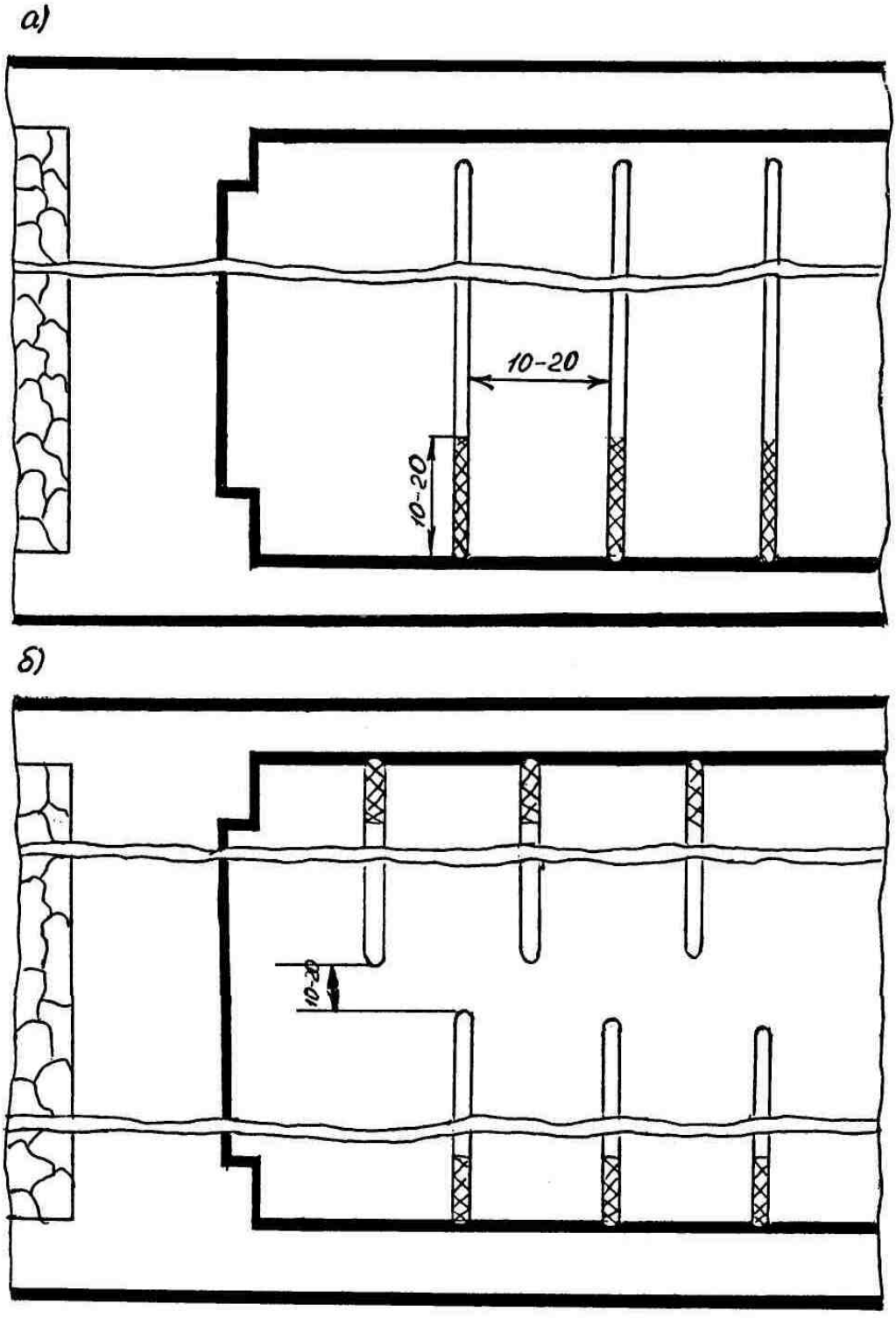
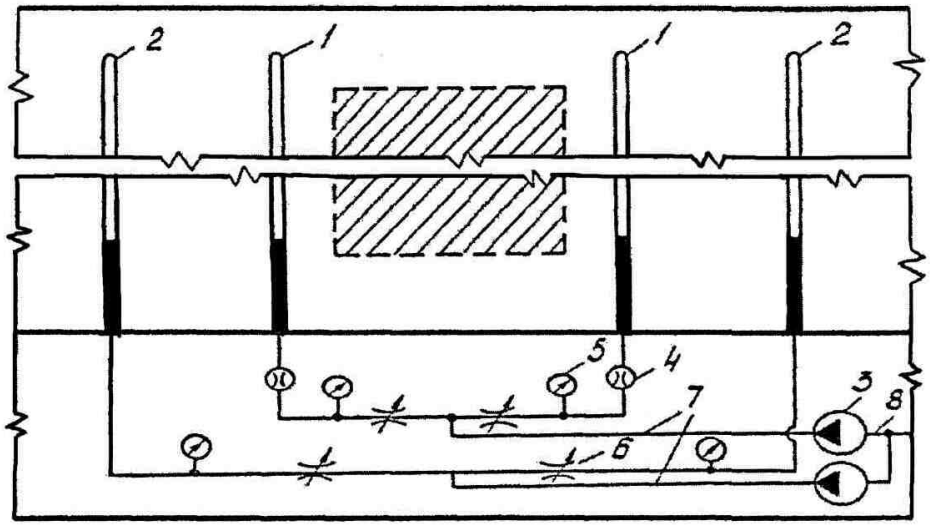


Fig. 2 Long boreholes:
a - from a preparation;
b (*б*) -from entries

а)



б)

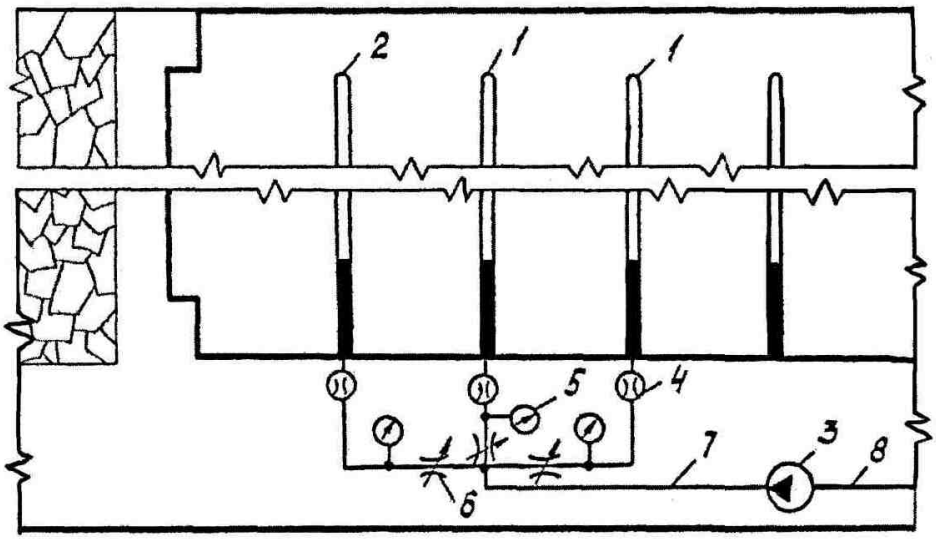


Fig. 3 Technological schemes of the Cascade with injection subsidiary wells

а) at a known location field;

б) by continuous technology

1 - injection wells; 2 - auxiliary wells;

3 - pump installation. 4 - counter-flowmeter;

5 - pressure gauge; 6 - adjustable choke;

7 - high-pressure hose; 8 - district water pipe

Air rate determined in accordance with the law of Darcy taking gas compressibility

The initial duration of the discharge cycle is determined by the conditions of near-total removal of free methane from coal volume filtration.

It is clear that the right choice of discharge pressure and cycle times can be reduced gas containing.

Over time, the duration of discharge cycles is reduced because of diminished concentration of free methane formation.

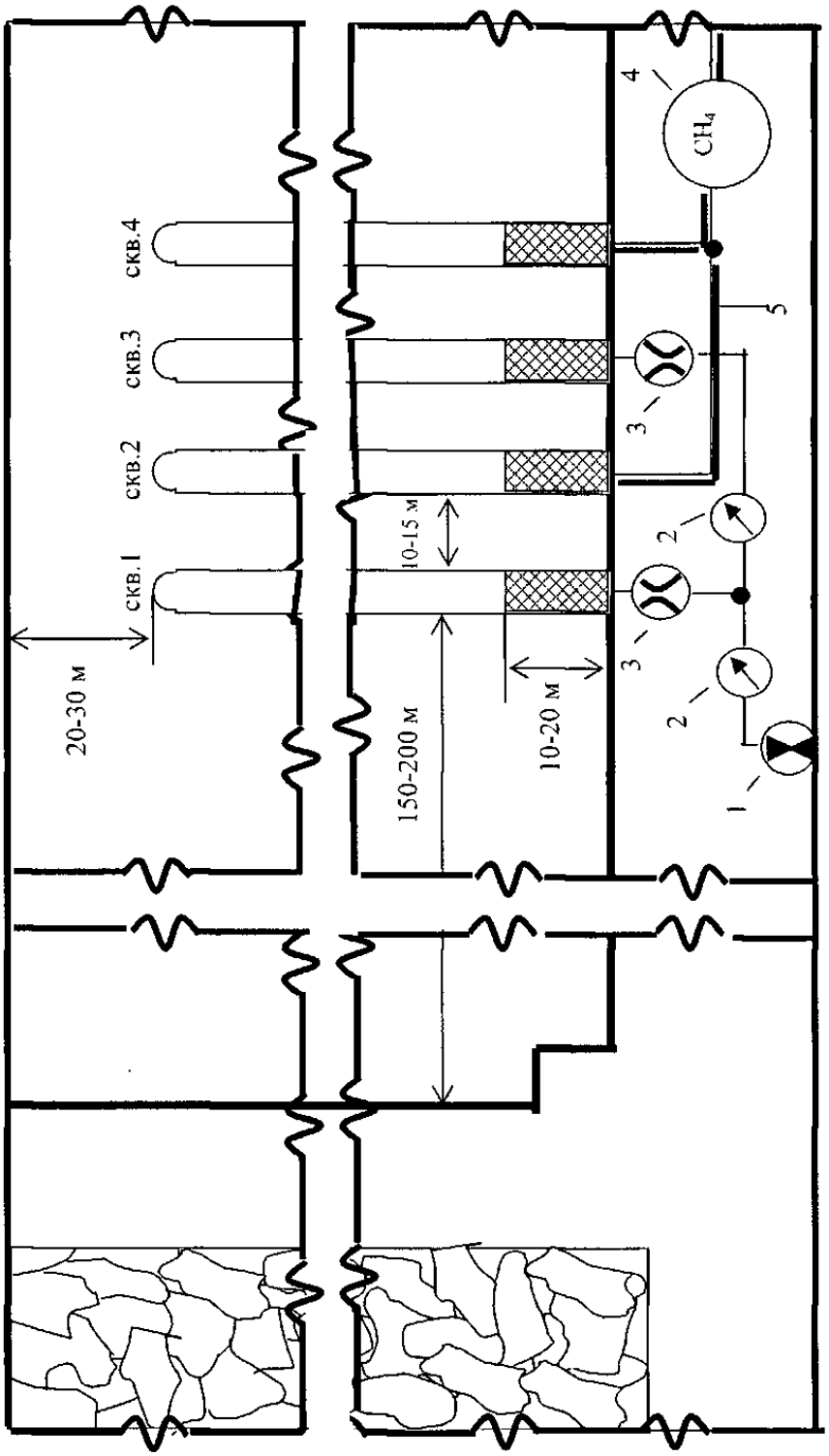


Fig. 4 The base variant of technological scheme of pneumatical action on coal stratum:
1 – compressor; 2 – manometer; 3 – counter-flowmeter of air;
4 – measurer of concentration of gas;
5 – mine gas-way.

Pneumatic action should check out when the air discharge of methane increases little takeaway. As shown by the results of modeling, this moment corresponds to the equilibrium concentration reduction, on average, by an order of magnitude.

On this point thanks to the results there are grounds to challenge the development of theoretical bases and technology integrated hydropneumatic impact on coal seams, which includes two stages.

1. Pneumatic processing of dry stratum. At this point is take away free and desorption methane. In addition, this method has a perspective regarding the change of physical and chemical state of the reservoir and, perhaps, would reduce the ability of the seam to spontaneous combustion.

2. Hydraulic impact. This kind of exposure through the use of technology allows the seam saturation liquid that reduces dust, reducing gas emissions and thus has a positive impact on working conditions in underground coal mining.

The wells used for circulating the air, can be used for subsequent injection of fluids.

Conclusion. Complex hydro-pneumatic impact provides targeted state change in the coal stratums to increase the load on the purge of culling, the pace of mine workings and labour protection.

Proposed integrated hydropneumatic impact on coal seams, which includes two phases:

- pneumatic processing of dry seam;
- hydro-treating using wells of pneumatic pumping.

A list of references. 1. Skochinskiy A.A. Whipping up the water into coal seam to be an effective tool in reducing dust undercutting of coal / Coal,1956, no. 8 – p. 31-34. 2. DNAOP 1.1.30-XX-1.04. Safe mining works on the seam prone to dynamic phenomena (1-st Edition). – K.: Ministry, 2004. – 268 p. 3. V.N. Pavlysh, S.S. Grebyonkin Physics-technical basis of hydraulic impact on coal seams / Monograph. – Donetsk, "VIC", 2006.–269 p.