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Lava Ventilation Technology in Coal Mines

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ABSTRACT: The methods of airing the end section of the lava, located on the border with the worked out space, are considered. Airing options due to mine depression and with an additional traction source (fan) with the removal of the outgoing stream into the ventilation drift and panel production are given.

KEYWORDS: development-free system, exhausted space, methane, amount of air, aerodynamic resistance, depression, gas mobility.

I.INTRODUCTION

Among the promising systems for the development of powerful shallow formations in gas mines is the development system described in [1]. The essence of this system (Fig. 1) consists in preparing excavation columns with two drifts, leaving pillars of coal of width r between them, working pillars on the same line with the lava, and ventilating the AB lava section using pipes laid on the soil of the drift drift. One of the main parameters of this method is the diameter of the pipeline, designed to divert the outgoing stream.

The article presents the results of calculations of the amount of air in the pipeline at different diameters for the following ventilation options:

- due to general mine depression without a jet exit and with a jet exit into the ventilation drift;
- a suction fan without a jet outlet and with a jet outlet into the ventilation drift.

II. SIGNIFICANCE OF THE SYSTEM

When airing due to mine depression, it is necessary to determine the diameter of the pipeline at which the amount of air in it will correspond to that necessary for airing the dead end section of AB lava. For the case of removing the jet without leaving the jet into the ventilation drift, we consider a section of the ventilation network consisting of a ventilation drift and a pipe stand and consisting of two parallel branches.

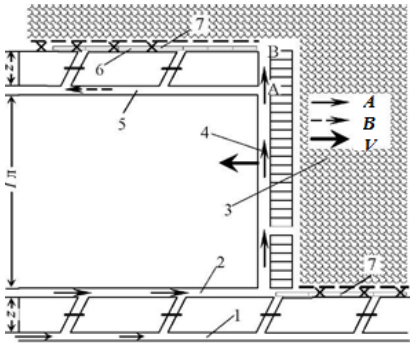

Fig. 1. The technological scheme of the development of the reservoir without leaving the pillars between the extraction columns

1 - conveyor drift; 2 - auxiliary (redeemable) drift; 5 - ventilation drift; 6 - blockage (former conveyor drift); 4 - face; 3 - worked out space; 7 - becoming pipes; A and B are fresh and initial air jets, respectively;

B - direction of lava movement

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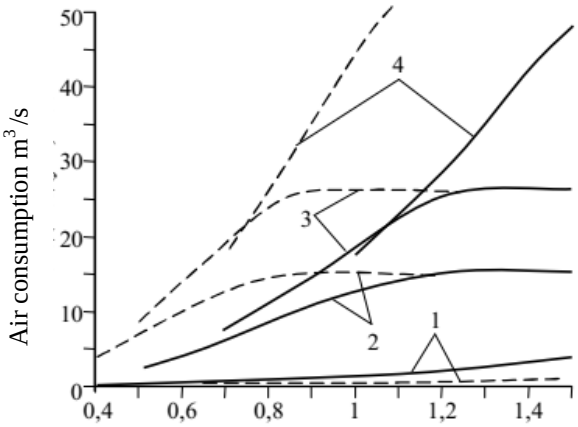
III. LITERATURE SURVEY

In accordance with the laws of air movement through ventilation networks [4], the amount of air in the pipeline depends on the resistance of the lava, ventilation drift and the pipeline. Methods for calculating the listed resistances are described in detail in [2, 3].

Similarly, the calculation of air flow in the pipeline with the exit of the jet into the ventilation drifts. In this case, when calculating the length of the ventilation drift is replaced by the distance from the bottom to the nearest malfunction. When the ventilation stream approaches the ventilation drift along the lava, part of the air turns into the ventilation drift, while the other continues to move higher along the lava and then enters the pipeline laid in the quenched mine, then into the pipeline in a failure, and from there it is delivered to the ventilation drift.



• Fig. 2. The dependence of the air flow in the pipeline on its diameter 1, 2, 3, and 4, respectively, when airing due to a shaft depression or a fan VTsG-7M, UVTsG-9, and UVTsG-15; A and B - when ventilating without leaving the jet into the ventilation drift and with the exit, respectively

IV. METHODOLOGY

It should be noted that the amount of air in the pipeline during ventilation due to shaft depression is practically independent of the length of the pipeline, since when it changes, the depression in the pipe also changes.

If the amount of air supplied to the upper part of the lava due to the mine depression is not enough to ventilate it, a suction fan can be installed in the panel or in the local malfunction (Fig. 2). As you can see, when a fan is connected to a pipe with a diameter of 0.6 m or more, the amount of air in it to ventilate the upper section of the lava is already quite large. In this case, the fan power is too high and their performance is ten times greater than the amount of air without them.

In a similar way, a fan can be selected for an existing pipeline, or, conversely, pipeline parameters for a particular fan are determined.

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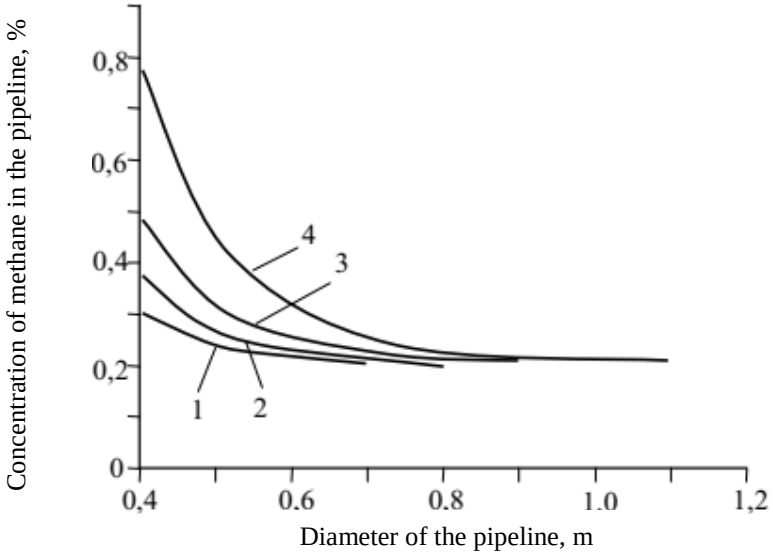

Fig. 3. Dependence of the concentration of methane in the pipeline on its diameter when ventilated by a fan. See legend in Fig. 2.

V. EXPERIMENTAL RESULTS

Since, according to safety rules for coal mines, the maximum permissible concentration of methane in the pipeline for insulated methane removal is 3.5% [2], dilution to the methane concentration of 1% should be carried out at the outlet of the jet from the pipe. For the considered options, graphs of the dependences of methane concentration in the pipeline were constructed for an absolute bottom gas abundance of 15 m3 / min (Fig. 3).

According to the graphs, when ventilating with a fan, the methane concentration in the pipeline does not exceed 3.5% already at a diameter of 0.4 m. Therefore, the use of larger pipelines will allow creating a reserve in case of a sudden increase in methane production.

VI. CONCLUSION AND FUTURE WORK

Thus, the most effective dilution of the methane-air mixture is achieved when ventilating with the help of a fan with the removal of the outgoing stream through a pipeline located in the fault closest to the treatment face, into the ventilation drift.However, given that the maximum permissible concentration of methane in the pipeline is 3.5%, and in the ventilation drift 1%, the scope of this method is limited by the need to lighten the jet in the ventilation drift to dilute methane to the appropriate concentration or to provide a concentration in the pipeline of 1%. This requirement also applies to the option with the exit of the jet from the pipeline into the ventilation drift due to the general mine depression. The issue of refreshment in these conditions requires a separate consideration. The disadvantages of this option include the need to move the fan as the lava passes failures, and, possibly, the remounting of pipelines. In this regard, the most optimal way to ventilate the zone of the inter-main pillar should be considered the method with the location of the fan in the panel production. At the same time, a safe concentration of methane in the pipeline is achieved, its dilution is ensured when exiting the fan, and work safety is improved by placing the fan away from the working area, which will eliminate the ingress of toxic and combustible gases to the site in the event of a fan accident.

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