Gas Emission Control on Longwall Panels at the Vorkuta Coal Mines

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ABSTRACT

The characteristics of geological conditions and mining technology at the coal mines of Coal Stock Company Vorkutaugol are given in the article. Information about longwall panel ventilation schemes and problems caused by high methane emission is also presented. The results of experiments at longwall panels using the methane emission control ventilation complex are described as well as ways of isolating gob methane removal. Other topics include the methane emission control ventilation complex consisted of drainage entry, an isolating wall with windows, mixing chambers and regulating stoppings. As results of experiments have shown, the most effective gas emission control methods were: the application of gas sucking fans for the isolated gob methane removal, and isolating walls at the line exposed to the gob. Encouraging results were obtained by use of two-entry mining system with yielding pillar between entries, homotropal ventilation and isolated methane removal from the gob.

KEYWORDS

Longwall, Ventilation, Methane, Emission, Gob, Control, Complex, Removing, and Experiment.

INTRODUCTION

The Vorkutskoe coal deposit is located in the northeast part of the Pechora Basin of Russia. The deposit represents brachysincline (trough), extended 30 km in length in the direction from the north to the south at an average width about 10 km. The working seams have thickness from 0.9 up to 4.2 m; inclination on trough wings from 6-7^0 up to 45-60^0 and about 0^0 in the bottom part of trough. The maximum depth of seams bedding is 1200 m. Natural methane content of the coal seams reaches 20-25 m^3/t. The absolute methane content at some mines reached 170 m^3/min.

Nowadays, mines using simultaneous mining range from 2 up to 4 coal seams, and longwall pillarless mining systems with homotropal ventilation is the only mining system used. The depth of mining has reached 1000 m, the longwalls and roadways come close to the bottom part of a trough. Longwall width varies from 120 to 270 m, and length of panels from 1000 to 2000 meters. The increase of mining depth has aggravated the rock bursts and sudden gas outbursts problems, as well as impacted effective ventilation of mining sections, and roadway maintenance in pillarless mining systems. The highest gas content is from the longwall panels of the Tchetverty seam (thickness 1.4-1.6 m) where gas emis-sion reaches 70-75 m^3/t. Although the designed longwall capacity for the Tchetverty is 2,500 t/day, due to ventilation problems, daily output is limited to only 1300 t.

A large disadvantage of the homotropal panel ventilation schemes at the Tchetverty seam is that the flowing through gob methane enriches air leakage coming into the supported conveyer entry behind the longwall and creates conditions for the accumulation of local methane. Quite often, more than 2% methane concentration in airflow has been detected in section of supported area behind the longwall entry on board with the gob by as far as 200-250 m from longwall.

EXPERIMENTS

To eliminate the local and layering methane, the experiments on ventilation complex testing were carried out at the mines of Coal Mining Stock Company Vorkutaugol. The ventilation complex consisted of drainage entry, isolating walls with windows, mixing chambers and regulating stoppings.

Ventilation complex testing in 1994-1997 has shown how methane in supported entries behind the longwall varies in different conditions. The isolating wall makes methane emission in regular intervals on the entire length of supported behind the longwall entry. When isolating wall is absent methane will be emitted during the first 200-250 m of entry. The intensity of methane emision is reduced several times (down to 0.05 m^3/min) in the section with isolating wall.

The windows in the isolating wall and mixing

chambers with regulating stoppings allow the local output of methane-air mixes from gob to be carried out. However, methane-air flow, its stratification throughout the height of a gob because of small speed, and small cross-section of drainage entry (0.5-1.0 m^2) result in a significant part of methane and air passing through gob, instead of through the drainage entry. The last circumstance much reduces opportunities of controlling the methane-air flow by the above mentioned ventilation complex. At rather high efficiency of the gob methane emission control, this ventilation complex does not allow complete elimination of local methane accumulations in supported entries behind the longwall. In the entry sections with controlled methane-air flows out of the gob, the air leakages have variable character (Figure 1).

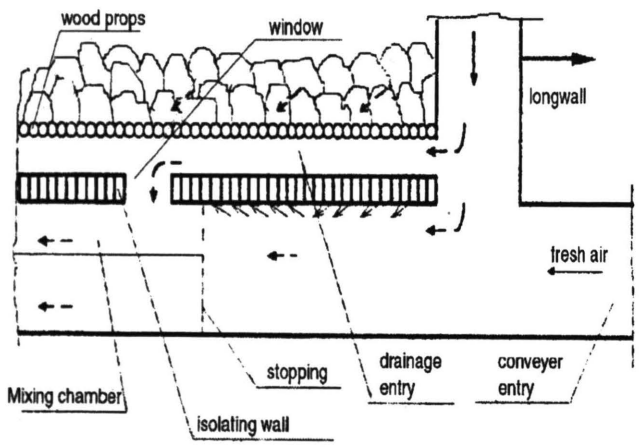

Figure 1. Gob methane emission control ventilation complex.

The air leakages are directed to gob on a 40-60 m site of supported behind the longwall entry where regulating stoppings, "windows" and mixing chambers have been installed, and to opposite direction - on the other sites of entry. On these sites the local methane accumulations, caused by isolating wall undensity, are observed. To eliminate the local methane accumulations. It is necessary to establish up to 4 regulating stoppings with mixing chambers. It is very difficult to achieve complete tightness of the isolating wall because of its continuing deformation. One of the ways of gob methane emission control is the isolated methane removal. At the Vorkuta coal mines the isolated methane removal operates by two ways:

1. With use of mine ventilating pressure drop.
2. With use of gas exhaust fans VMCG-7.

During experiments with the above mentioned ventilation complex, the joint work of this complex and exhaust fan VMCG-7 was observed too. It was established that the influence of VMCG-7 on gob methane income to supported entries behind the longwall is possible only when the distance between the longwall and fan is no longer than 500-700 m.

To eliminate the local methane accumulations in supported entries behind the longwall with ventilation complex it is recommended to install an exhaust fan in this entry near the longwall (Figure 2). VMCG-7 fan is installed in the stable or directly in the entry at 200-400 m from longwall. The sucking pipeline is installed into the isolating wall window and the place of input of the pipeline into the window is carefully isolated.

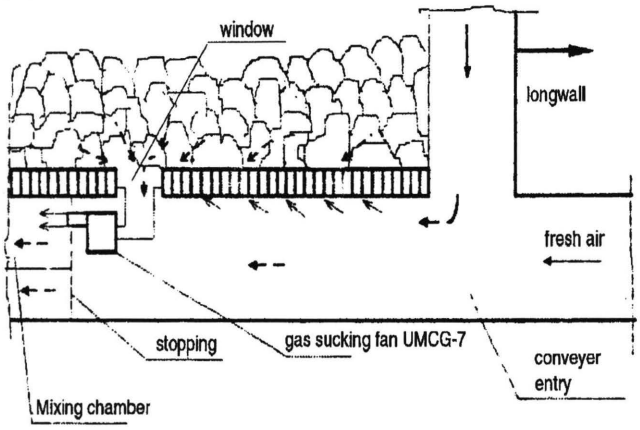

Figure 2. Gob methane emission control with use of gas sucking fan VMCG-7.

Drawn by the negative pressure created by VMCG-7 fan, the methane-air flow comes to fans through the sucking pipeline. The methane-air flow passed through the fan comes through the pipeline to the mixing chamber where it is diluted by the ventilating airflow down to required methane concentration.

The isolated wall constructed on the board with gob, and drainage entry allows dispersal of the gob air-methane flow on a longer distance behind the longwall. It reduces both the methane emission to the supported entries behind the longwall entry and probability of local methane accumulations formation. The efficiency of gob methane airflow control with the isolating wall can be increased by use of gas exhaust fans.

CONCLUSIONS

Thus, various control facilities and panel ventilation modes were tested to eliminate the local methane and layered methane accumulations. The most effective among them were: the application of gas sucking fans for the isolated removing of methane from the gob, and using isolating walls at the line exposed to the gob.

The encouraging results were obtained by use of two-entry mining system with yielding pillar between entries, homotropal ventilation and isolated methane removal from the gob.

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