ABSTRACT

The importance of proper control of ventilation in order to achieve the desired effect, i.e. qualitative and quantitative air distribution in the mine's ventilation network is presented at the beginning. It was pointed out that the required (by the regulations in force in the Polish underground mining industry) classical method of ventilation control does not always meet the assumed objectives. In this context, new solutions are shown which are possible to apply, but only with the permission of the head of the mine's operations unit. It was emphasised that in connection with the increasing depth of exploitation and the increase in the level of natural hazards, in particular methane and climate hazards - in the era of the ongoing restructuring of the Polish underground mining industry and reduction of expenses related to investments in mines, including investments for the main access and ventilation headings and the deepening of ventilation shafts - ensuring the necessary amount of air requires a new look and application of non-standard solutions.

Next, the legal status concerning the control of air currents, changing over the years and currently binding in hard coal mines, was presented, with particular attention paid to choosing the place for the installation of a brattice in the aspect of the conducted mining company's operation and the impact of the depression of the ventilation shaft on the goafs of the exploited and liquidated longwalls, as well as ensuring the ventilation stability. A scientific objective was presented in the context of the proposed solutions, i.e. to document the positive impact of ventilation control in the used air current, and a utilitarian objective, i.e. to promote changes in the concept of ventilating the headings in the mine's ventilation network through the wide application of ventilation control in the used air current.

The further part of the paper presents basic laws, concepts and definitions related to the ventilation of mines. Typical examples of inlet air control are given and attention is drawn to the risks arising from the use of classical ventilation control. This applies to significant pressure on the brattices installed at the inlets to the shaft chambers and the hazards resulting from the possible occurrence of a "short ventilation short-circuit", as well as the need to install control dams along the route of the unit’s haulage system in the case of ventilation control in the mining areas and the impact of such control on insulation dams or geological disturbances.

Issues related to the calculation of the mine's ventilation network were next presented, including the methodology of performing the measurements necessary to create a computer image of the ventilation network. Parameters related to the stability of air currents and ventilation are presented, such as isentropic potential, pressure loss, district current stability index and power current index. These parameters were used in the further part of the work to describe the individual methods of ventilation control.

The idea of using control in the used air current is presented in the next part of the work, which forced the application of new solutions. This made it possible in the presented example, among others, to decommission two peripheral shafts and design longwalls with considerable runoffs, to abandon the deepening of another ventilation shaft, and to reduce the number of active longwalls from 14 to 3-4.

Adverse aspects related to the control of ventilation in the intake air current are also shown, as well as the principles of using control in the used air current to ensure the required safety level.

The main part of the work presents and discusses real examples of the application of ventilation control in the group and district used air current.

In the case of ventilating the shaft chambers, the focus was put on eliminating the phenomenon of "short ventilation short-circuit" and eliminating dams with significant pressures at the inlets to individual chambers. It was shown that a group of several control dams built on inlets to several shaft chambers can be replaced by one control dam built in a group current of used air. The safety conditions that such control must meet are presented at the same time. The above is presented in potential diagrams showing the impact of the place of installation of the control dam on individual network nodes.

The paper demonstrates that the control of ventilation in the district current of used air may have a positive impact on the effect of depression of the main ventilation fan (installed at the ventilation shaft) on the goafs of exploited and liquidated longwalls, geological disturbances and the flow of goaf gases between individual operations of one mining plant. It was also demonstrated that such non-standard ventilation control ensures stable ventilation of mining areas without negative effects. The indicators characterising the air currents guarantee a safe way of ventilating the given district air currents. As in the case of ventilation of shaft chambers, the safety conditions that such control must meet are presented, and the potential diagrams show the impact of the place of installation of the control dam on individual network nodes.

An analysis of tests results was carried out in the further part of the work, depending on the place of installation of the control dam, with calculating the values of aerodynamic potentials, air current capacity and current stability index. The results are presented in tabular form.

The doctoral dissertation, based on real examples of the application of ventilation control in the used air current, showed that:

- in the case of applying the control in the group current of used air, in particular, the reduction of air losses in the currents of air ventilating the shaft chambers, classified as spaces with the "a" class of methane explosion hazard, was achieved and at the same time the effect of "short ventilation short-circuit" was eliminated,
- when the control is applied in the district used air current, in particular, the fire hazard in exploited goafs and longwalls being liquidated was reduced due to the reduced impact of the main ventilation fan's depression on exploitation and post-exploitation goafs of longwalls and insulation dams, increased stability of ventilation of mining areas and elimination of the hazard related to the possibility of flows of goaf gases poor in oxygen and with high methane concentration between individual operations of the mining company in the liquidated excavation, ventilated with separate ventilation, which was subject to the depression of the main ventilation fan.

Finally, the assumed thesis of the doctoral dissertation was proved. It was also pointed out that the scientific objective of the doctoral dissertation and the utilitarian goal were achieved.