FACTORS AFFECTING AIR DENSITY IN AQUEDUCT VENTILATION VIA STVOL

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ABSTRACT

In this article, we analyze the change in the ΔR value by improving the method for determining the real density change in the studied area and determining the aerodynamic resistance of the stvol perimeter to determine a more accurate average value of air density without making additional intermediate measurements between the measurement points. The results of the analysis were mainly considered compression of air under the influence of their own weight, depression of the head fan, deceleration of air velocity and hydrostatic compression of air.

Keywords: Air movement, density, flow, measuring points, aerodynamics, vintelator, mining sediments, mine, stvol environment, depression, velocity, boundary, plot, atmosphere, pressure, temperature.

INTRODUCTION

Currently, a world-class scientific research is carried out on the topics of improving the air and gas dynamics of the mine, mining atmosphere and methods of its control, separation of waste gases, sudden outbursts of various gases, mine fires, mine dust. The results of fundamental and applied research, as well as the technical questions solved by them: distribution of gases in the earth's crust, types of bonds between gases and rocks, estimation of gas content in deposits, methods for controlling methane emissions in deposits, methods for calculating aerodynamic resistance of mining reservoirs, gas and dust transition processes in mining reservoirs, heat exchange processes in mines, mine ventilation design It is of priority importance in solving the main problems of aeration of deposits, such as methods, reliability of mine ventilation systems.

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LITERATURE REVIEW

To determine the aerodynamic resistance of the stvol environment in mines, the amount of air passing through the stvol and the depression of the plot are determined by the following formula:

$$\Delta R = \frac{\Delta P}{Q^2_{stvol}} \qquad (1)$$

Here ΔP is the depression of the stvol environment under study, Pa; Qstvol – the amount of air passing through the stvol, m3/s.

The amount of air passing through the stvol is determined by means of the transverse cross-sectional surface of the mining lagoon, which merges with the stvol along its entire length, and by measurements of the airvelocity in these laiths.

$$Q_{\text{СТВ}} = \sum_{j=1}^{n} v_j * S_j \qquad (2)$$

where vj is the velocity of air movement in the lament, m/s; Sj – transverse cross-sectional surface of the lament, m²; n is the number of lakhs to be measured.

The depression at point 1 of the studied stvol section (the "1" point is located above "m", the direction of air movement depends on the performed function of the stvol) is determined taking into account the process of simulating the measured pressure values:

$$\Delta P = \sum_{i=2}^{m} \left(P_{i-1} - \left(P_i - \rho_{o\prime rta(i-1)-(i)} * g * \Delta h \pm \Delta P_{Amm}\right)\right) \qquad (3)$$

where pressure measured at point Pi-1 – (i-1), Pa; Pi – (i) the pressure measured at the point, Pa; m – lower limit of the studied station plot; ρ'middle$_{(i-1)-(i)}$ – average air density at points (i-1) and (i) of the study plot, kg/m3; g – acceleration of free fall, m/s²; Δh = hi–hi-1 – depth of the plot, m (hi and hi-1 – height marks of measuring points i and i-1, respectively); ±ΔPAtm – change in atmospheric pressure, Pa (sign "+" – increase in atmospheric pressure, sign "–" – decrease in atmospheric pressure).

The value of atmospheric pressure density in the law of thermodynamics:

$$\rho = \rho(P, T, \xi) \qquad (4)$$

where P is the absolute pressure of air, P_a; T – air temperature, °C; ξ is the absolute humidity of air, g/m³. The parameters included in Equation (4) are measurable magnitudes, which are determined at points "1" and "i", so ρ also remains as a known magnitude only at these points. Air pressure, temperature, and humidity change as the mining deposits deepen, so the air density varies differently at measurement points.

To determine the average density of air in the perimeter of the station "1-i" under study, we use the method of a linear equation:

$$\rho_{o\prime rta(1-i)} = \frac{\rho_1 + \rho_i}{2} \qquad (5)$$

"1-i" of the environmental environment under study is divided into several equal parts for experimental measurements of thermodynamic parameters (pressure, temperature and humidity) of air. The more points of measurement and the smaller the distance between them, the less error in the method of linear equations. Determining the number of measuring points is the next task in the development of a methodology for determining the aerodynamic resistances of the stvol. In order to determine a more accurate average value of the air density without carrying out additional intermediate measurements between the measuring points, it is necessary to determine the real change of ρ in the studied area. The density varies under the influence of the following factors: compression of air under the influence of its own weight;

depression of the main ventilator and other sources of gravity, including deceleration of air velocity under the influence of natural gravity; hydrostatic compression of air (a temperature change in density as a result of evaporation-condensation processes); A change in the amount of moisture.

Each of the factors listed above can significantly affect air density. This can be determined by the comparative analysis of the results of numerical modeling of the vertical direction of the air density, taking into account each factor separately and together [1].

CONCLUSION

Thus, an improvement in the methodology for determining the aerodynamic resistance of the ambient air between two measuring points will consist of a change in the value of ΔR, wherein a nonlinear vertical motion of the absolute air pressure will be recalculated taking into account all the factors listed above, so that the graph $P_{(h)}$ is measured in P_{i-1} and P_i until they get through the pressures. However, in the process of modifying ΔR, the equivalent value is also selected, which provides the measured consumption.

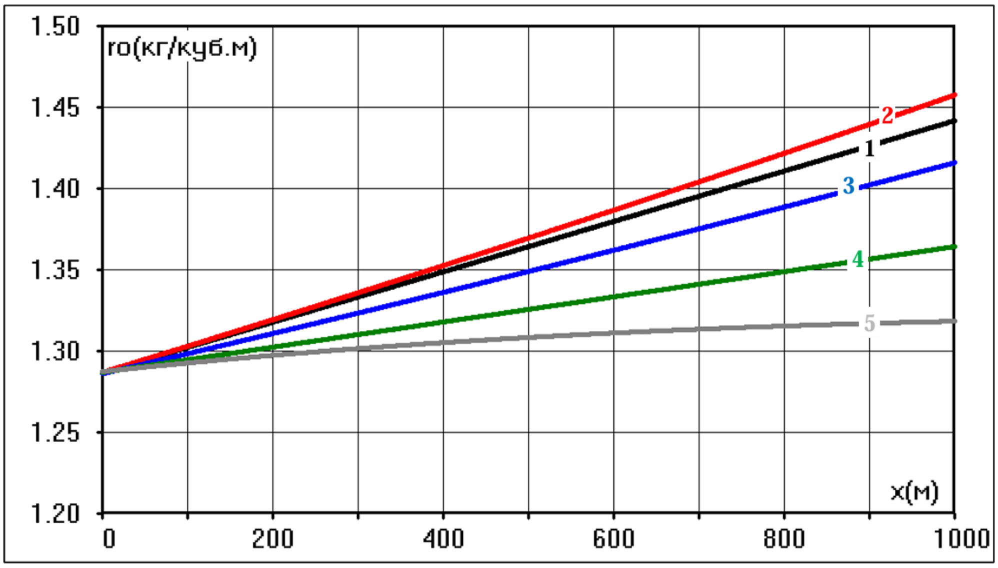

Figure 1. The calculated values of the change of air density ρ in depth and the graph determined by taking into account various factors in the air supply stvol: 1 – the continuity of ρ when calculating the increase in pressure P with depth; 2 – gravitational compression; 3) – gravitational compression and depressive decrease; 4 –hydrostatic heating of the air; 5 – Heat exchange during STVOL strengthening

Figure 1 presents the calculated results of modeling the change in air density in depth on the KS-2 air supply stall. Based on the results of the calculation, the dependence of the air on the content of humidity is not taken into account. The influence of the remaining factors on the density change is significant, and a change of up to 10% of ρ can be observed at a depth of several kilometers, according to Figure 1. Analyzing the correlations in the figure, we can conclude that the deviation of the air density graph from the linear position on a section of several kilometers is ~0.005 kg/m³, or 0.3% of the mean value of the density. This means that carrying out measurements at the edge points of the reservoirs in which the study is being carried out will give concrete results. It is not possible to clarify the linear interpolation of the parameters between these points, and it is necessary to use a linear mean calculation to calculate the average density of the air density of the surrounding area.

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