Defining of the required parameters of the main fans on the ventilation shaft for the target model of the hard coal mine Y in connection with its decommissioning

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Abstract. The article presents the results of the analysis and calculations of the ventilation network of the decommissioned hard coal mine Y for the model of its target operation. After the end of hard coal mining and the liquidation of most of the mining excavations, the former Y hard coal mine will become an element of the drainage system and a protection for other, still active mining plants. In order for the Y excavation to be transformed into a mine water pumping station, its ventilation system should be rebuilt, and new parameters of the main fan should be determined for a smaller network of mining excavations. For this purpose, using the AERO-2016D program by POK "Zachód" Spółka z o.o., the parameters of the ventilation network were simulated in the target model of mine Y after the liquidation of the "Southern" shaft and mining excavations at levels 530m and 660m. The results of the simulation made it possible to select the optimal main fans for the target model of the transformed mine Y.

1. Introduction
Due to the changing climatic conditions in the world and the so-called global warming [1], the policy of the European Union countries is aimed at a significant reduction of carbon dioxide generated as a result of hard coal combustion, and thus limiting the extraction and closure of hard coal mines. In the most optimistic scenario, outlined by the Inter National Panel on Climate Change (IPCC), the energy sector in developed countries is expected to become zero-emission by 2030. In a pessimistic - until 2045. [2]. Western agencies monitoring climate change and think tanks would like the production of energy from coal in Poland to decline by twenty times by 2030. This result will certainly be difficult to achieve, but it is already visible today that Poland is gradually moving away from energy generated from coal in favor of other renewable energy sources, especially solar and wind [3]. Significant changes in this regard were brought by the mining reform implemented in 2015-2017, as a result of which Spółka Restrukturyzacji Kopalń S.A. in Bytom put into liquidation 13 hard coal mines. Today, the process of their liquidation is not only an economic and environmental aspect but is also important from the point of view of the safety of other active coal mining plants in Poland. Especially in the field of water and methane hazards [4]. Therefore, in connection with the final stage of transforming the mining infrastructure of the former coal mine Y into a stationary underground water pumping station, it is necessary to change the operating conditions of the main fans of mine Y. The existing ventilation system of mine Y was based on two North and South ventilation shafts and three I, III, IV intake-air shafts. The operating parameters of the WPK-5.0 and PRJ - 280 / 1.4 main fans installed on the ventilation shafts were adapted to the conditions of coal mining in an active mine and ventilation of the network of over
90 km of own workings and approximately 12 km of workings of the "S" hard coal mine. The intensive liquidation of over 70% of active mining excavations of the Y mine in 2016-2020 reduced the demand for the amount of air in other mining excavations. In addition, the planned target model of the mine assumes the liquidation of further shafts and ventilation of the stationary pumping station at the level of 850m with the help of only two shafts (intake-air and ventilation) with a simplified ventilation network of ca. 10.7 km of workings. In connection with the above, Mine Y plans to modernize the main fan station at the South ventilation shaft.

Therefore, it seems reasonable to ask the question: Are the operating parameters of the current fans located at the "South" shaft in the target model of mine Y appropriate to ensure the stability of the ventilation network of mine Y in the new conditions?

2. Current model of the Y hard coal mine

After the liquidation of a significant part of the mine workings of the former Y coal mine and liquidated intake-air shafts (material and transport shafts III and IV) carried out in 2016-2020, the coal deposit in the mining area of the "Y mine" is now accessible from the surface:

- a) shaft I, material and transportation (intake-air), with a diameter of 5.7 m. Providing levels: 530m, 660m, 850m,
- b) the "Northern" shaft (ventilation) located in the north-western part of the mining area of mine Y with a diameter of 7.5 m. Providing levels: 530m, 660m, 850m,
- c) the "Southern" shaft (ventilation) located in the central part of the mining area of mine Y, with a diameter of 6.0 m. Providing the level of 530m.

Shafts I and "South" perform the function of intake shafts, and shaft "North" is a ventilation shaft.

Mine Y has the following main mining levels: 530m, 660m and 850m. The Y mine has a rock and coal deposit structure. Its main core consists of the guideline to the west and east at the level of 530m, connecting shaft I with the northern shaft. At the level of 660m, the main workings include guideline 506 and the MR drift connects Shaft I with the South shaft. Subsequently, at level 850: the V drift and the VR drift, constituting the ventilation connection of the Y Mine with the S Mine.

| Table 1. Technical parameters of the fans at the "Northen" shaft |
|---------------------------------------------------------------|
| **Fan** | **Parameters** |
| Type | Fan No.1 and No.2 |
| | WPK-5.0 radial, single-stream |
| Producer | Zabrzeńska Fabryka Maszyn Górniczych |
| | POWEN |
| Installation spot | Northen Shaft |
| Number of turns | 375 rpm. |
| Nominal capacity | 20 500 m³/min. |
| Nominal depression | 3330 Pa = 340mm H₂O |
| Power | 1600 kW |
| Tension | 6 kV |
| Engine | GYe 1616t/01 synchronous |
| d of capacity and damming regulation | steering camera |
| Flap control | electric |
| Own source. |

At the ventilation shafts: North and South, there are two main ventilation fan stations. The parameters of the installed fans are presented in Tables 1 and 2:
Table 2. Technical parameters of the fans at the "Southern" shaft

| Fan no.   | Parameters                                      | Parameters                                      |
|-----------|------------------------------------------------|------------------------------------------------|
| Fan no. 1 | WPK-5.0 radial, single-stream                   | PRJ – 280/1,4M uniaxal                         |
| Type      | Zabrzańska Fabryka Maszyn                       | Fabryka wentylatorów                           |
| Producer  | Górniczych POWEN                                | Fawent S.A.                                    |
| Installation spot | Northern Shaft                             | Szyb Południowy                               |
| Number of turns | 375 rpm                                      | 490 rpm                                       |
| Nominal capacity | 20 500 m³/min.                               | 15320 m³/min.                                 |
| Nominal depression | 340mm H₂O                                     | 321mm H₂O                                     |
| Power     | 1600 kW                                        | 1600 kW                                       |
| Tension   | 6 kV                                           | 6 kV                                          |
| Engine    | GYe 1616t/01 synchronous                       | S1710Y-12A synchronous                        |
| d of capacity and damming regulation | steering camera                             | steering camera                               |
| Flap control | electric                                     | electric                                      |

3. The procedure for updating the mathematical and graphic model of mine ventilation network Y.

In order to update the mathematical and graphical model of the ventilation network of Mine Y the actual distribution of the aerodynamic potentials of the ventilation network was determined, which became the basic information base for determining the safety of the ventilation network, its stability, rational ventilation and damming up management (August 3-4, 2020).

Employees of the ventilation department of mine Y and the external company POK "Zachód" Spółka z o.o. performed a series of underground ventilation measurements in designated nodes and sidings of the ventilation network of mine Y. Simultaneously with underground measurements, meteorological measurements were made on the surface.

On the surface, the measurements were carried out in such a way that a designated person took a reading every 15 minutes (Table 3):

- atmospheric pressure with a precision aneroid with an accuracy of 0.2 mbar (20 N / m²),
- dry and humid air temperature using the Asman psychroaspirator with an accuracy of 0.2 °C.

Table 3. Examples of the results of measurements carried out on the surface

| measurement time | barometric pressure | dry temperature | humid temperature | humidity X₀ | virtual temperature Tvo |
|------------------|---------------------|-----------------|-------------------|-------------|------------------------|
| h, min           | hPa                 | °C              | °C                | kg/kg       | K                      |
| 8,00             | 1006,0              | 20,2            | 17,0              | 0,0098      | 296,0                  |
| 8,15             | 1006,2              | 20,0            | 17,6              | 0,0102      | 296,5                  |
| 8,30             | 1006,4              | 20,0            | 19,0              | 0,0105      | 296,5                  |
| 9,00             | 1006,6              | 21,4            | 18,0              | 0,0106      | 297,9                  |
| 9,15             | 1006,8              | 21,6            | 19,6              | 0,0101      | 297,2                  |
| 9,30             | 1007,0              | 22,0            | 19,2              | 0,0103      | 298,6                  |
| 10,45            | 1007,2              | 23,0            | 19,2              | 0,0099      | 298,6                  |

Own source.
Underground measurements were carried out by three measuring groups of two people. For each measurement group, spatial diagrams were prepared in advance. The diagrams show the directions of air flow, ventilation dams, and characteristic nodes where the measurements were carried out.

1) Each group made the following measurements, noting the time of their preparation:
   • mine air pressure, with a precision aneroid with an accuracy of 0.2 mbar (20 N / m²) in designated siding junctions,
   • air flow velocity in sidings with the use of a vane anemometer and the cross-section of sidings and calculation of air expenditure,
   • pressure drops on ventilation dams, with a liquid pressure gauge (U-tube).

   The results of measurements of air quantity and pressure in the nodes of ventilation sidings and the pressure difference on the ventilation dams were used to prepare a numerical model (Figure 1).

4. Adopted methodology for updating the mathematical and graphic model of mine Y
To change the mathematical and graphic model of the Mine Y ventilation network, a computer program supporting the work of the ventilation engineer AERO-2016D [5] was used, which allowed for:

a) updating the spatial ventilation pattern of mine Y by adding new sidings and eliminating redundant sidings. Marking the missing air flow directions, supplementing the numbering of the ventilation network nodes. The licensed BrisCAD program was used for this purpose.

b) introduction to the numerical model:
   • the amount of air obtained from ventilation measurements in mine Y,
   • calculated resistance of ventilation network sidings (method described below),
   • the results of the actual characteristics of the main ventilation fans in the form of an analytical record based on the current data registers of mine Y,

c) control calculation of the model and elimination of errors based on actual underground measurements.

4.1. Determination of aerodynamic potentials in nodes of the ventilation network
The spatial diagrams of the potential ventilation networks of mine Y preserve the relationships between the individual nodes of the network (these connections are network sidings). Each point is assigned to an appropriate potential.

The isentropic potential of air "$h" in the network node with the leveling height "$z" is determined in relation to the zero potential on the strand of the inspiratory shaft with the leveling height "$z_0$".

This potential is described as (1) [6] i [7]:

$$h = p - p_s$$  \hspace{1cm} (1)

where:

- p - mine air pressure influenced by main fan depression and natural depression, [Pa],

- $p_s$ - dry air pressure creating an isentropic stratified atmosphere in the network that would prevail in the network in each node in the absence of main fan operation and natural depression., [Pa],

Dry air pressure is calculated from the formula (2):

$$p_s = p_0 \left( 1 + \frac{g(x_0+2)}{c_p T_v} \right) \frac{H}{H-1}$$  \hspace{1cm} (2)
Figure 1. The current diagram of ventilation of mine Y (own source)
After introducing the symbols:

\[ z = \frac{g(z_o - z)}{c_pT_v} \]

\[ H = 1.4, \quad \frac{H}{H-1} = 3.5 \]

\[ y = (1 + z)^{3.5} \]

According to the formula (3):

\[ p_s = p_o y \]  \hspace{1cm} (3)

Thus, finally the formula (2) looks like (4):

\[ p_s = p_o \left( 1 + \frac{g(z_o + z)}{c_pT_v} \right)^{3.5} \]  \hspace{1cm} (4)

where:
- \( p_o \) - atmospheric air pressure in the cross section of the intake shaft, [Pa],
- \( z_o \) - leveling height of the cutting area of the intake shaft, [m],
- \( z \) - leveling height of the center of the siding cross-section for which the potential is determined, [m],
- \( g \) - acceleration due to gravity, \( g = 9.81 \text{ [m/s}^2\text{]}\),
- \( c_p \) - specific heat of dry air at constant pressure, \( c_p = 1005 \text{ [J/kg K]}\),
- \( H \) - polytropic transformation index of dry air, \( H = 1.40 \)
- \( T_v \) - virtual temperature of the atmospheric air in the cross section of the intake shaft, [K],

The virtual temperature is determined by the affiliation (5) i (6):

\[ T_v = (1 + 0.6 \cdot x)T \]  \hspace{1cm} (5)

\[ T = t_s + 273 \]  \hspace{1cm} (6)

where:
- \( T \) - absolute temperature of the atmospheric air in the cross section of the intake shaft, [K],
- \( t_s \) - dry bulb temperature on the cutting area of intake shaft, [°C],
- \( x \) - specific humidity of the atmospheric air, [kg/kg] (7).

\[ x = 0.622 \frac{e}{p-e} \]  \hspace{1cm} (7)

where: \( e \) - partial pressure of water vapor contained in the air, [Pa].

The aerodynamic potential was determined for each node based on the formulas (1-7) using the Excel application.

The obtained values of aerodynamic potentials, as experience show, contain measurement errors of various sizes.

These errors arise from:
- instability of the ventilation network caused by the opening of ventilation locks, movements of cages and skips in shafts during measurements,
- changes in atmospheric pressure,
• accuracy of measurement and reading of barometric pressure,
• inaccuracy in determining the leveling height of the node in the ventilation network.

The resulting errors were eliminated by analysis of:
• mine ventilation network,
• leveling heights of adjacent nodes,
• dependence of the barometric pressure and changes in the leveling height of the siding and the presence of ventilation devices in the above-mentioned sidings (ventilation dams, lute fans).

4.2. Determination of the aerodynamic resistance of sidings of the ventilation network.
With the results of the aerodynamic potential and a quantitative balance of air in the ventilation network of mine X, the calculation of the aerodynamic resistance of the sidings was started [6] (Table 4).

The siding resistances $R$ were calculated based on the following formula:

$$ R = \frac{\Delta W}{V^2} \quad (8) $$

where:
- $R$ – siding resistance, [Ns/m$^8$; kg/m$^7$; Bd],
- $\Delta W$ - difference in aerodynamic potential (pressure loss), [mmH$_2$O; N/m$^2$; Pa],
- $V$ – volumetric air flow rate, [m$^3$/s].

Table 4. An example of the aerodynamic resistance and air expenditure of the ventilation network of mine Y

| Starting node | End node | Resistance (kg/m $^7*1000$) | Expenditure (m$^3$/min) | Dissipation |
|---------------|----------|-----------------------------|------------------------|------------|
| 1             | 20       | 160                         | 7576                   | 2551       |
| 1             | 104      | 1500                        | 2757                   | 3167       |
| 20            | 21       | 11.6                        | 13240                  | 657        |
| 91            | 266      | 12                          | 184                    | 0          |
| 100           | 42       | 50                          | 343                    | 2          |
| 203           | 707      | 25000                       | 33                     | 8          |
| 215           | 217      | 120                         | 3646                   | 443        |
| 322           | 320      | 5200                        | 140                    | 28         |

Own source.

In sidings of the ventilation network with ventilation dams, the dam (locks) resistances are a component of the calculated resistance of the entire siding. Additionally, some aerodynamic resistances were determined mathematically. The aerodynamic resistances prepared in this way were entered into the AERO-2016D ventilation engineer's work support program from POK Zachód Sp. z o.o. This program includes a computational program for the transformation of numerical data (stacking, expenditure) and presenting them in the form of a polynomial describing the characteristics with its graphic image. Based on this program, current fan characteristics were introduced into the mathematical model of mine ventilation network Y. After entering the input data into the computational program and converting it, a preliminary mathematical version was obtained. This version was analyzed to verify the correctness and compliance of the entered data and their influence on the obtained calculations. Corrections were also introduced, which consisted in adjusting the resistance of several sidings.

Successive calculations of the ventilation network of the model resulted in satisfactory approximations to the real state. Then, using the BrisCADy program, a graphic program was launched, thanks to which the current model of mine ventilation was obtained.
5. Analysis of the ventilation network of Mine Y based on a digital model

Based on ventilation measurements, calculations of aerodynamic potentials and using the AERO 2016D software, an up-to-date representation of the ventilation network of mine Y was obtained, the shortened balance of which is as follows:

1. The air to the workings of mine Y is brought through the intake shafts:
   - shaft I in the amount of 6446 m$^3$/min,
   - of the South shaft in the amount of 853 m$^3$/min.

2. An amount of fresh air inflow to the mine workings is 7299 m$^3$/min.

After ventilating the ventilation areas of mine Y, the air is discharged to:
   - own North ventilation shaft (without external losses) in the amount of 5664 m$^3$/min,
   - excavations of the neighboring mine with a permanent connection to mine Y - a connecting drift at the level of 850m in the amount of 1636 m$^3$/min.

In total, air is discharged from the workings of mine Y through shafts in the amount of 5664 m$^3$/min. The fan is choked and draws air in the amount of 7468 m$^3$/min together with external losses.

The WPK 5.0 type centrifugal fan of the main ventilation with parameters (Figure 2) is operating at the "Northern" ventilation shaft:

- damming $\Delta P_c = 3116$ N/m$^2$
- efficiency $Q = 13240$ m$^3$/min (221m$^3$/s)
- equivalent hole $A = 4.71$ m$^2$

![Figure 2. Parameters of the main ventilation fans at the "Northern" shaft.](image)

6. Defining the required parameters of the main fans on the ventilation shaft for the target model of the mine

The appointed team of experts to determine the target model of the mine after the completion of the mine decommissioning process proposed two variants of conceptual considerations, which were analyzed for the designed representation of mine Y’s ventilation network for the optimal determination of the parameters of the main fans on the North ventilation shaft. The analyzed concepts included the replacement of the existing main fans on the North shaft at:
Variant I - maintaining the current network of excavations.

Variant II - liquidation of all redundant excavations of mine Y and maintaining a ventilation connection with mine S. (This solution is significant due to the further exploitation of coal in mine S, and the need to supply air from mine Y to some of the workings of this mine S.).

Variant III - liquidation of all redundant excavations of mine Y with a ventilation connection to mine S. (This solution is important for economic reasons to maintain the main pumping station at the level of 850 in mine Y).

6.1. Analysis of the designed mapping of the Y mine network for variant I

To maintain the required ventilation parameters, the fan is currently regulated by the main flaps installed in the ventilation duct. Thanks to such regulation, the main ventilation fan on the North shaft works steadily, giving the required parameters. The computer network analysis shows that to obtain better operating parameters, fans should be used that match the currently required operating points of the network.

Based on the mapping of the current model of mine Y's ventilation network, a simulation was performed by implementing in the AERO 2016D program the characteristics of new smaller radial fans operating in parallel and an axial fan with adjustable blades on the rotor. As a result of these activities, the mapping of the ventilation network was obtained, in which the abbreviated balance is as follows:

1. The air to the workings of mine Y is brought through the intake shafts:
   • shaft I in the amount of 6403 m$^3$/min,
   • the South shaft in the amount of 846 m$^3$/min.

2. A total of 7249 m$^3$/min fresh air inflow to the mine workings. After airing the ventilation areas of mine Y, the air is discharged to:
   • own North ventilation shaft (without external losses) in the amount of 5611 m$^3$/min,
   • excavations of the neighboring mine with a permanent connection to mine Y - a connecting ditch at the level of 850m in the amount of 1639 m$^3$/min.

In total, air is discharged from the workings of mine Y through shafts in the amount of 5,611 m$^3$/min. The fan is choked and draws air in the amount of 7525 m$^3$/min together with external losses.

At the "North" ventilation shaft, a radial fan operating in parallel or axial with the following parameters was proposed (Figure 3):
   • damming $\Delta P_c = 3187$ N/m$^2$
   • efficiency $Q = 7529$ m$^3$/min (125m$^3$/s)
   • equivalent hole $8A = 2.68$ m$^2$
The results of the computer simulation showed that the proposed change of the main ventilation fans to centrifugal fans operating in parallel or an axial fan with adjustable blades did not result in significant changes in the ventilation network. In this way, a comparable total air expenditure in the mine was obtained. Moreover, damming up on the main ventilation fans and the distribution of aerodynamic potentials in this ventilation network is similar to the current state. All these changes should positively affect the maintenance of a stable ventilation system and reduce the fire risk. However, this solution is not very effective.

6.2. Analysis of the designed mapping of the Y mine network for variant II.

The pits of the 530m, 660m ventilation levels and the southern shaft have been removed from the current ventilation model. The ventilation connection with the S mine was maintained.

The simulation of the ventilation network model for this variant was made taking into account the inclusion of the radial fans operating in parallel or the axial fan with adjustable blades on the "Northern" shaft and the sealing of the core of the "Northern" shaft. When adjusting the target model, it was necessary to close the ventilation dams on the Ventilation Pier (siding 530-533). As a result of these activities, the mapping of the ventilation network was obtained, in which the abbreviated balance is as follows:

1. The air to the workings of mine Y is brought through shaft I in the amount of 3,728 m³/min,
2. In total, the fresh air inflow to mine workings is 3728 m³/min.

After airing the ventilation areas of mine Y, the air is discharged to:
- own North ventilation shaft (without external losses) in the amount of 1979 m³/min
- excavations of the neighboring mine with a permanent connection to mine Y - a connecting ditch at the level of 850m in the amount of 1748 m³/min.

In total, air is discharged from the workings of mine Y through shafts in the amount of 3,149 m³/min.

At the "Northern" ventilation shaft, a radial fan operating in parallel or axial with appropriate blade arrangement at appropriate rotational speeds with parameters (Figure 4) was proposed:

- damming \( \Delta P_c = 952 \text{ N/m}^2 \)
- efficiency \( Q = 3129 \text{ m}^3/\text{min} \) (52 m³/s)
- equivalent hole \( A = 2,0 \text{ m}^2 \)
Figure 4. Parameters of the main fans at the "Northern" shaft - Variant II

The results of the computer simulation show that due to the planned liquidation of the workings for the target model of mine Y with the main pumping station at the level of 850m, the amount of air flowing through the mine workings has decreased (from 7249 m³/min to 3728 m³/min). Damage to the main ventilation fans in relation to the current state (after the use of new fans) is also positively reduced to 963 N/m². At the same time, the difference in aerodynamic potential formed in this network by the operation of the main fan has also decreased. The above changes should reduce the fire risk.

6.3. Analysis of the designed mapping of the Y mine network for variant III.
In this variant, the excavations of the 530m and 660m ventilation levels and part of the 850m level excavations, and thus the connection with the "S" mine, were removed from the current ventilation model (Figure 5):

Figure 5. Target ventilation scheme of mine Y (my own source)
The simulation of the ventilation network model for this variant was made taking into account the inclusion of the radial fans operating in parallel or the axial fan with adjustable blades on the "Northern" shaft and the sealing of the core of the "Northern" shaft. When adjusting the target model, it was necessary to close the ventilation dams on the ventilation drift (siding 530-533). As a result of these activities, the mapping of the ventilation network was obtained, in which the abbreviated balance is as follows:

1. The air to the workings of mine Y is brought through shaft I in the amount of 1798 m³ / min,  
2. The total fresh air inflow to mine workings is 1798 m³ / min.

After the ventilation areas of mine Y are aired, the air is discharged to its own northern exhaust shaft (without external losses) in the amount of 1798 m³ / min.

In total, air is discharged from the workings of mine Y through shafts in the amount of 1798 m³ / min. with external losses of 2,922 m³ / min.

At the "Northern" ventilation shaft, a radial fan operating in parallel or axial with appropriate blade arrangement at appropriate rotational speeds with parameters (Figure 6) was proposed:

- damming $\Delta P_c = 887 \text{ N/m}^2$
- efficiency $Q = 2922 \text{ m}^3/\text{min} (52 \text{ m}^3/\text{s})$
- equivalent hole $A = 1.96 \text{ m}^2$

![Figure 6. Parameters of the main fans at the "Northern" shaft - Variant III](image)

After considering the assumptions of this variant, the amount of air flowing through mine workings Y in the target model was further reduced to 1798 m³ / min. Also, the damming on the main ventilation fans was positively reduced to 887 N / m² - which was noted in the values of aerodynamic potentials in the entire ventilation network. Therefore, further improvement in shaping the state of fire hazard is to be expected. The proposed changes should also have a positive impact on maintaining a stable ventilation system of the newly built pumping station located at the level of 850m, which is to receive a total inflow of underground water in the amount of 4.5 m³ / min from the levels of 400m, 530m, 660m and 850m.
7. Conclusions

The conducted research shows that:

- Closure of hard coal mines in Poland is dictated not only by economic considerations, but also by a change in climatic conditions in the world and the desire to reduce carbon dioxide emissions.
- The process of decommissioning deep hard coal mines in Poland is a complex process that must consider both the environmental conditions and the safety aspect of active mining plants.
- The vast majority of mines in Poland are permanently liquidated, and the land after them is transferred to municipalities for further activities outside mining. In some cases, however, it is necessary to adapt the mining infrastructure of the mine being liquidated to a new function related to the regulation of water management in a given region, which is important not only for the safety of other mining plants, but also for the safety of cities and municipalities of their inhabitants.
- Adapting the liquidated mine to its new function requires considering many conceptual and investment changes. One of the most important conditions in this respect is the safe design of the ventilation network for the new target model of the future stationary groundwater pumping station located in the mine workings of the former mine.
- The article presents the results of the analysis and calculations of the ventilation network of the decommissioned hard coal mine Y, which show that the current amount of air supplied to the mining excavations by the main ventilation fans is too large and therefore it is necessary to select new fans that would be adequate to the current and future operating points of the network ventilation.
- As a result of the simulations of the ventilation network for three different variants of the target model of the mine, it was found using the AERO 2016D program that for the target model of mine Y, smaller radial fans should be used, e.g. WPK 2.6 by POWEN company operating in parallel or axial fans with adjustable blades on the rotor, e.g. type dAL20 by Korfmann.
- The analysis of the target models of the mine in terms of the stability of the ventilation network also showed that, from a practical and economic point of view, the best solution for the target model of the mine is to adopt variant III, i.e. reduce the network of mine workings of mine Y to a minimum and eliminate the ventilation connection with mine at the level of 850m.
- The AERO-2016D program by POK Zachód Sp. z o.o. is a great diagnostic tool that facilitates the work of a ventilation engineer, which allows for a quick analysis of the ventilation network and avoiding investment errors.

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