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VENTILATION SOLUTION FOR MAO KHE COAL MINE WHEN CONNECTING WITH A PAIR OF VERTICAL WELLS AT LEVEL +25/-400 M, MAO KHE COAL COMPANY, VIETNAM

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1. Introduction

Mao Khe Coal Company is a subsidiary of Vietnam Coal and Mineral Industries Group (Vinacomin). Currently, the mine is exploiting the project underground from -150 or more with a pair of inclined wells, coal mining output in 2022 is 2.08 million tons. At the same time, Mao Khe coal mine is also building a tunnel project to a depth of -400 m (continue below) with a pair of vertical wells with a design capacity of 2.50 million tons/year.

This study aims to provide suitable solutions to complete the ventilation system for the mine, ensure the environment and safety, and help consider the effective investment for the mine in the future.

2. Research Methods

The underground coal mining area of MaoKhe Coal Company was selected as the research area in the work. With the research methods used: statistics, inheritance, theoretical research and field studies for the purpose of evaluating in detail the current status of mine ventilation system.

3. Calculation and assessment of ventilation for Mao Khe mine

3.1. Current ventilation for mine in 2022

** Mine wind network diagram*

According to the current mining plan, in order to ensure an output of 2.08 million tons/year, the mine must mobilize 16 longwalls (including 10 horizontal longwalls) and 14 preparation digging tunnels.

The current diagram of the mine wind network is constructed from the tunnels with 16 longwalls and 14 preparation digging tunnels as shown in the mine ventilation diagram in Fig 1. In general, this is a very complex wind network. The mine area is ventilated by suction ventilation method, with 4 main fan stations (in Fig 2).

Currently, the mine is mainly exploiting the project level -250m and above. Using a pair of inclined wells combined with underground tunnels passing through the main coal seams at levels: -230, -150; -80, -25, and horizontal tunnels at levels: +130, +200, +350, and use inclined tunnels to ventilate mine areas.

** Calculate current wind flow for mine*

The overall wind volume of the mine is determined by the following formula:
Qm = 1.1(1.1 x 185.4 + 74.6 + 17.7 + 20) = 347.7 m3/s
The wind volume of the assigned areas is calculated as follows:
Fan station at the door of tunnel the level +69: Qm1 = 76 m3/s.
Fan station at the door of tunnel the level +120: Qm2 = 176 m3/s.
Fan station at the door of tunnel the level +25: Qm3 = 21,18 m3/s.
Fan station at the door of tunnel the level +45: Qm4 = 74,5 m3/s.
Calculation results determine the working mode of the main fans at the furnace door at levels +69m; +120m; +25m and +45m as shown in Figure 3.

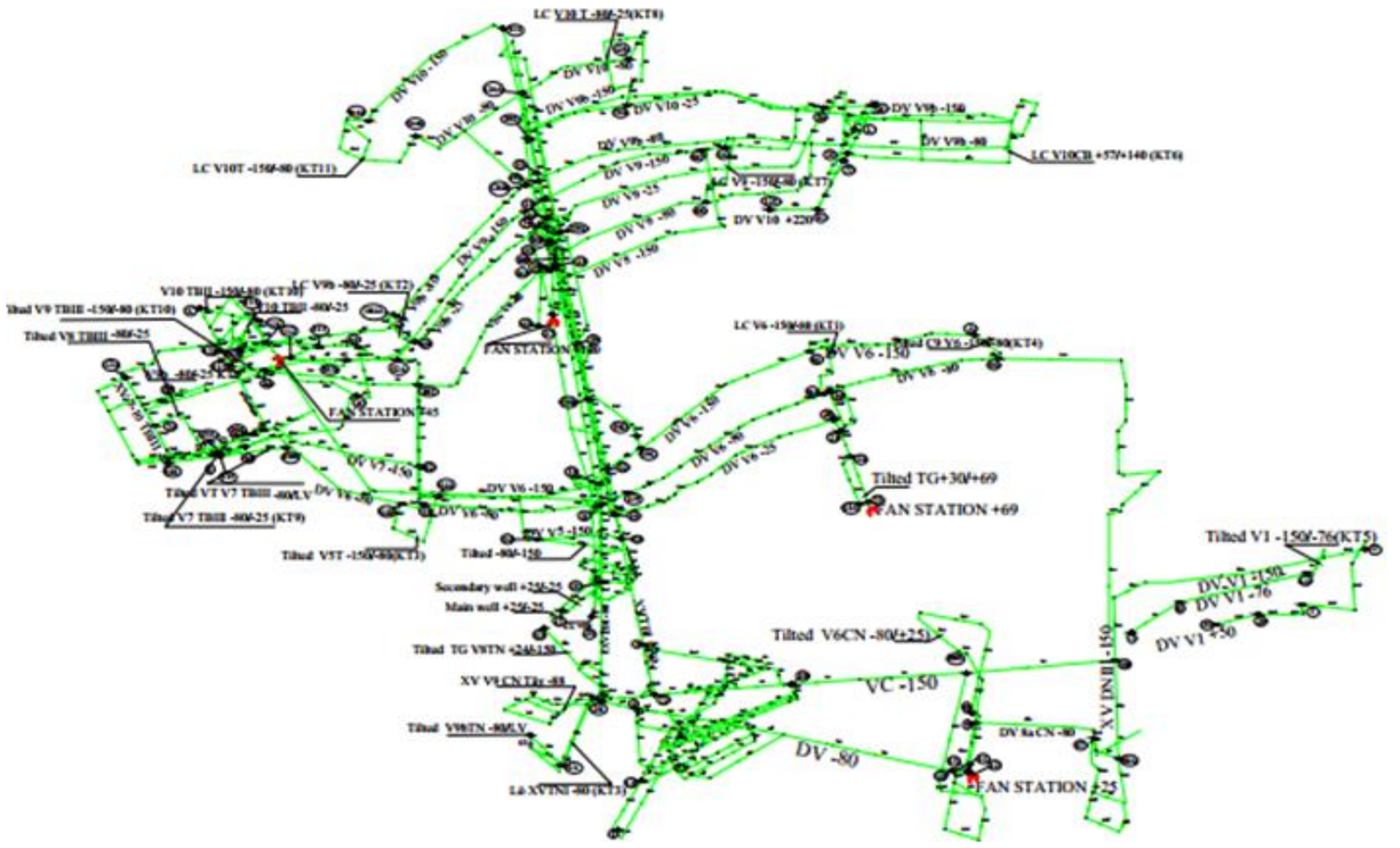

Fig.1. Ventilation diagram of MạoKhe mine

Fig.2. Image of main fan station 2K56-No24 at the door of tunnel the level +69, level +120, level +45

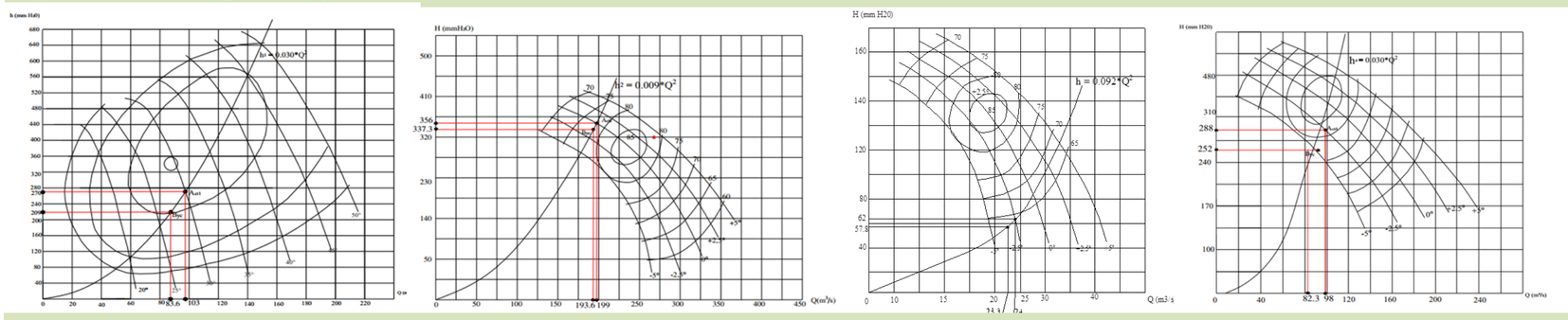

Fig.3. Calculation results determine the working mode of the main fans at the furnace door at levels +69m; +120m; +25m and +45m

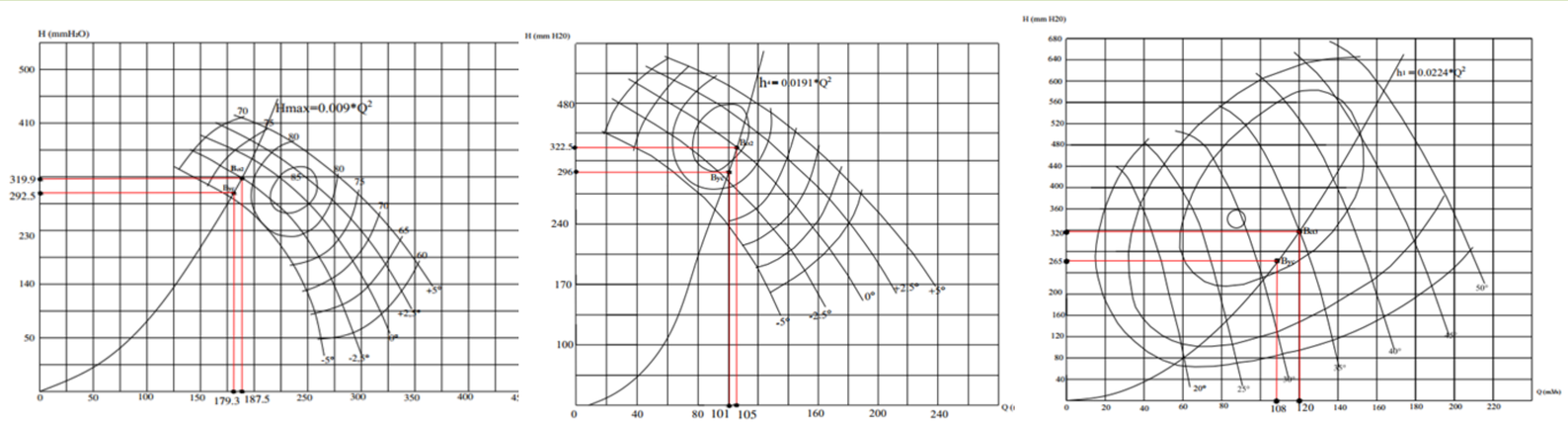

Fig.4. Calculation results determine the working mode of the main fans at the furnace door at levels +120m; +45m and +69m

3.2. Calculation of ventilation for the mine when connecting to a pair of vertical wells with a height of level +25/-400 m (in 2023)

The calculation of ventilation for the mine area when the mine wind network is connected to the pair of vertical wells is done similarly to the calculation of ventilation for the current mine, but according to the parameters of the mine at the expected time in the quarter 3 of 2023, and the output in 2023 is 2.35 million tons/year [8,10]. The results of the calculation are as follows:

* Calculate the wind flow for mine

With the condition of mining plan at the third quarter of 2023 of the mine, the calculation results of wind flow for the mine area are as follows:
Qm = 1.1(1.1 x 182,2 + 74 + 23 + 25) = 354 m3/s
- Fan station area at level +120: Qm+120 = 163 m3/s;
- Fan station area at level +45: Qm+45 = 92 m3/s;
- Fan station area at level +69: Qm+69 = 99 m3/s;

Calculation results determine the working mode of the main fans at the furnace door at levels +120m; +45m; and +69m as shown in Figure 4.

** Evaluate*

Thus, when the mine wind network is connected to a pair of vertical wells, the mine output will also increase compared to 2022. Basically, the wind network diagram has also changed due to the additional wind flow into the mine through the pair of vertical wells, and the resistance of the mine is also reduced somewhat and has an impact on the wind flows in the mine. Including the need to move some wind control doors to match the mine wind network when connecting to a pair of vertical wells at level -400/+27m.

4. Complete solution for mine ventilation system

With research results and references from many research works in the field of mining activities. We propose some solutions to improve the efficiency of the ventilation system for the mine in the current period and when connecting the wind network with the project's pair of vertical wells down to the depth of level -400m:

1- Orientation on ventilation method and fan arrangement

The mine ventilation still uses the suction ventilation method, and then only 3 fan stations are needed at +120, +45 and +69 levels.

2- Orientation of general wind demand to be put into the mine

When the underground project goes down to -400m deep and reaches the mining capacity, it is necessary to calculate to ensure the wind flow for the mine. Particular attention is paid to proper exploitation planning to create the simplest ventilation scheme, in which a maximum simultaneous exploitation plan must be developed at only one or two levels in an area, eliminating complete serial ventilation between longwalls.

3- Solution use main fan

When the mine's capacity reaches 2.5 million tons/year, the wind volume required for the mine increases, the ability of the FBDCZ-No27 fan at +45 is no longer sufficient. Therefore, then it is necessary to change the fan station at station +45 with a fan with a larger capacity that can be used with FBDCZ-No30 fan or FBDCZ-No35 fan or equivalent blower.

4- Optimal solution for main fan working mode

We propose the solution of using an inverter to adjust the working mode of the fan, optimizing the working mode. of the main fan, building the automatic mode of the mine wind system. At the same time, it helps to use electricity economically, efficiently and ensure environmental safety. With the use of an inverter, the fan's working mode will be adjusted according to the actual wind demand of the mine at each specific time.

5. Conclusion

In the future when connecting the current mine wind network with the pair of vertical wells of the mining project down to a depth of -400m, the required wind volume for the mine will increase, the wind network diagram will change and especially when mining Project exploitation at -400m with the content of gases released in the field will increase (especially CH4), it is necessary to strengthen the ventilation management, especially pay attention to the overall design Mine ventilation system ensures the highest efficiency of mine ventilation.

Our research results will be the basis to support Mao Khe Coal Company in the management and operation of mine ventilation, especially the investment and development of the mine in the coming period.

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