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SELECTING PARAMETERS TO DESIGN AUXILIARY VENTILATION IN UNDERGROUND MINE

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INTRODUCTION

In recent years, Quang Ninh coal mines are continually expanding on size and depth, the total length of the roadway each year amounts about ten thousands meters in order to reach new production zones. The length of new roadways is usually longer, leading to increase to the airflow demand. Ventilation is one of the main factors effecting driving progress of the roadway. The estimation of airflow requirements is usually based on the minimum amount of airflow required at the heading during driving roadways or at the working face, in other words, when the ventilation ductwork is at its maximum length.

Therefore, determination of maximum ventilation length of ductwork has been undertaken. This results allow the selection of a reasonable fan to meet the ventilation requirements when driving the roadway. Also, this value is an important parameter for designing auxiliary ventilation system that operates more efficiently on a lower cost.

METHODS AND MATERIALS

1. Model of conceptual analysis for calculating maximum ventilation length

Underground mine ventilation network analysis has not been much changed since 1935 when McElroy conducted the study of the engineering factors in the underground mine ventilation [5-6]. In the general case, the concept mathematical model of the auxiliary ventilation system is described by the following expression:

$$R_o . p . Q^2 = n . f(Q) \qquad (1)$$

Where: R_0: Theoretical friction resistance of ductwork (no air leakage in ductwork), kμ ;
f (Q): Analytic expression of the fan aerodynamic characteristic curve;
p: Duct leakage coefficient;
Q: Quantity of airflow, m^3/s;
n: Numbers of fans in series;

Resistance Ro is determined by the formula [8]:

$$R_0 = 6.48 * 0.00048 * \frac{L}{D^5} \text{ (k}\mu\text{)} \qquad (2)$$

Where: α: Friction factor for the duct, α= 0.00048 $KgF.s^2/m^4$;
L: Duct length, m;
D: Diameter of the duct, m.

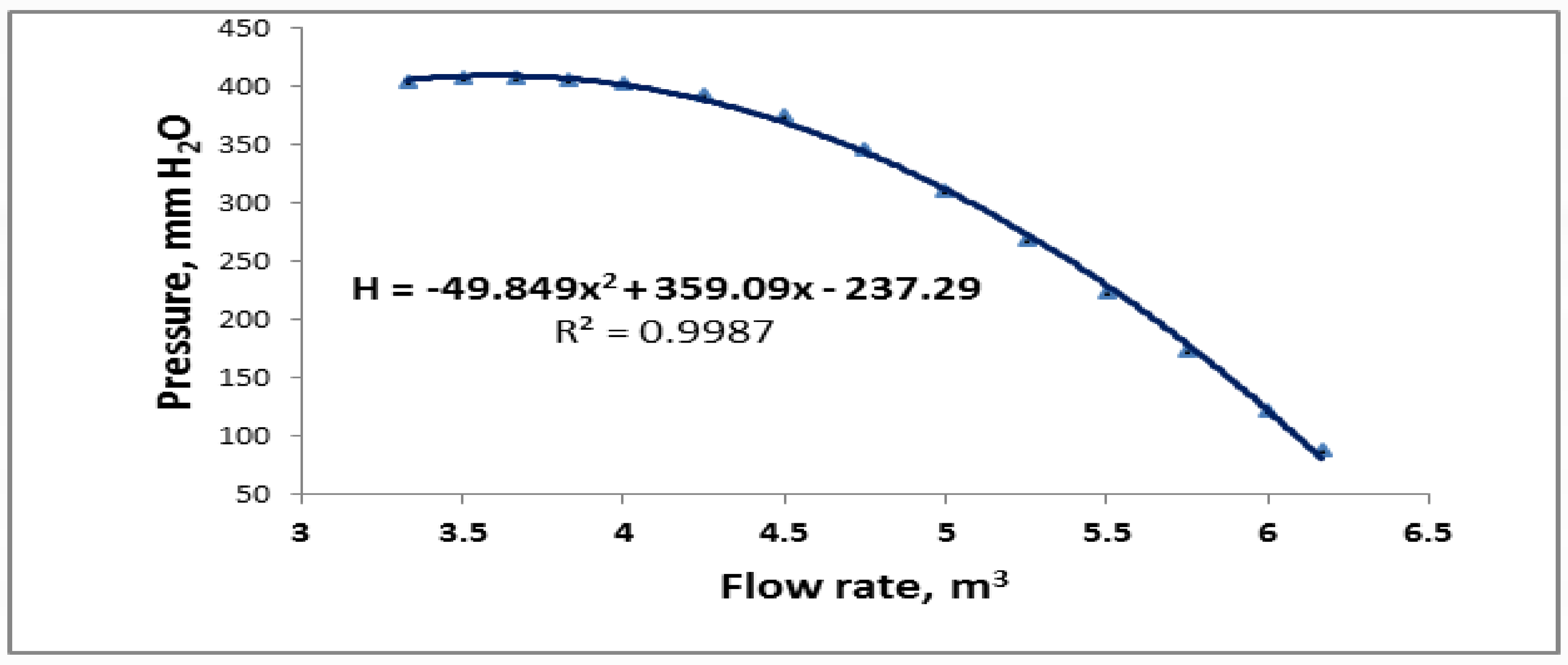

Figure 1. Pressure-volume characteristic curve for fan SDF $_{(A)}$-II-5.3/ 2x7.5

Equation (1) can be represented as follows:

$$6{,}48 . \alpha . \frac{L}{D^5} . p . Q^2 = n . f(Q) \qquad (3)$$

Estimating duct leakage coefficient- p and fan characteristic curve - $H = f(Q)$ in order to calculate the maximum ventilation length, which the fan can generate the required air flow.

2. Determining leakage coefficient

A conceptual prediction model has been proposed based on experimental data at Vang Danh Coal mine :

$$p = f(L, Q) \qquad (4)$$

Assuming that air leakage coefficient in the ductwork can be described to be in the form:

$$p = 1 + c * L^a * Q^b \quad (5)$$

Let p, L and Q represent leakage coefficient, duct length and quantity of airflow in the ducting system respectively.

The experimental data are made on 0.7 m diameter ducts over sections of ducts installing towards the working face in actual field conditions. Linear regression analysis by using Stata software to fit these experimental data can derive the relationship between the air leakage coefficient, the quantity of the air in the ductwork and the ducting length.

3.Analysis of the fan characteristic curve $H = f(Q)$

. Drawing figure representing the relationship between fan flow rate and pressure of fan to find fan characteristic curve as shown in Fig.1.

The fan curve $H = f(Q)$ for fan in the form of an inverse curve figure . Quadratic polynomial fit to these data is as follows:

$$H = -49.849 . Q^2 + 359.09 . Q - 237.29 \quad (6)$$

*4. **Calculating maximum ventilation length***

Combining equation (3) and equation (6) to calculate the maximum ventilation length L_{max}

RESULTS

Currently, in Quang Ninth mines, airflow volume Q supplying to the face changes from 2 to 8 m^3/s for the duct of D = 0.6 ÷ 0.8 m; sometimes 1.0 m for large cross-section roadway.

Under the conditions of this study: Using the fan SDF(A)-II-5.3/2x7.5 , the ductwork of 0.7 m diameter and amount of airflow required at the face Q= $4m^3/s$, maximum ventilation length L_{max} for SDF(A)-II-5.3/2x7.5 is 860 m

CONCLUSIONS

Analysis of fan characteristics and ductwork parameters in order to assess the reliability of the ventilation level when driving roadways. From the analytic equations it is possible to determine the maximum ventilation length that the auxiliary fan has enough capacity to ensure to bring the required airflow to the face. The equations to solve the problem of selecting the number of fans need to be used for the ducting system.These data can help designers and operators to select the appropriate fan in auxiliary ventilation systems.

A conceptual prediction model has been proposed based on the experimental data at Vang Danh Coal mine.

In addition, this is the basis for making a plan to equip ducts and fans to meet production requirements for each stage in underground coal mines.

The research results were used to optimize the auxiliary ventilation system that can save costs and energy.