A novel utilization direction for ventilation air methane: explosion power generation

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Introduction

- The mine ventilation air, one way of methane emission in which the methane concentration is less than 1%, constitutes approximately 70% contribution to the coal mine methane emissions.
- the ventilation air methane cannot be used as a conventional energy due to the low concentration.
- Nowadays, the low concentration gas power generation technology is well-developed. Notwithstanding this, the ventilation air methane has not been applied in large-scale due to the high utilization costs.
- an explosion power generation method is proposed and a considerable number of fundamental experiments are conducted systematically.

A novel utilization direction of the ventilation air methane - explosion power generation

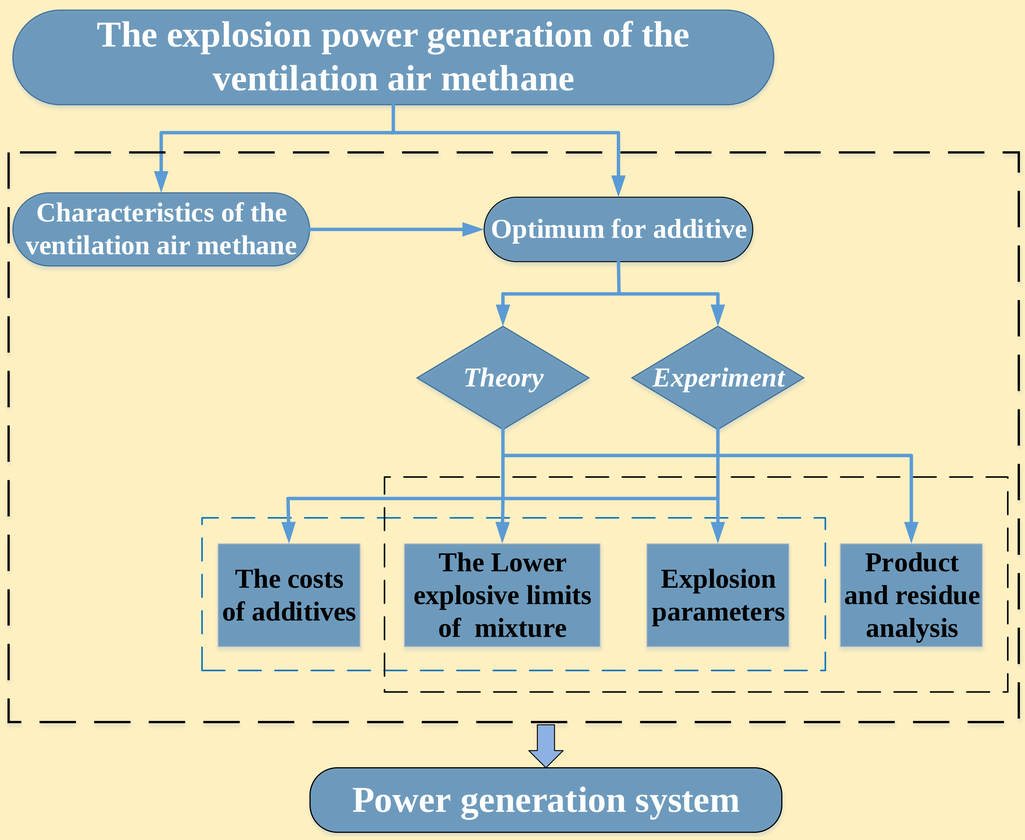

Fig. 1 *The general schematic view of research ideas*

The central idea of this utilization method is adding combustible substances (gases or liquids) to the low concentration gas to achieve the reduction of the lower explosive limits.

The theoretical analysis for optimum additive

- When the methane concentration is a constant and the explosive limits of the additive is known, then the concentration range of the additive can be calculated the explosive limits equation of the explosive mixture：

$$L = \frac{1}{\frac{Y1}{L1} + \frac{Y2}{L2} + \cdots + \frac{Yn}{Ln}}$$

- *Y1*, *Y2*...*Yn* is the component in the explosive mixture
- *L1*,*L2*...*Ln* is the explosion limit of each component

- Besides explosive limits, One of the primary of the reasons for the lower utilization of the ventilation air methane is the prohibitive costs.

$$costs\ of\ additive = \frac{V * Cv * n * P}{Vm}$$

- *V* is the total volvum of the mixture of nethane/additive, L
- *Cv* is the volume concentration, %
- *n* is the amount of substance, mol
- *P* is the price of the additive, yuan/g
- *Vm* is the molar volume of gas, mol/L

The experimental analysis for optimum additive

The explosion experiments on the lower explosive limit, ignition energy and the pressure characteristics, etc. of the dilute methane/additives are conducted in spherical explosive apparatus.

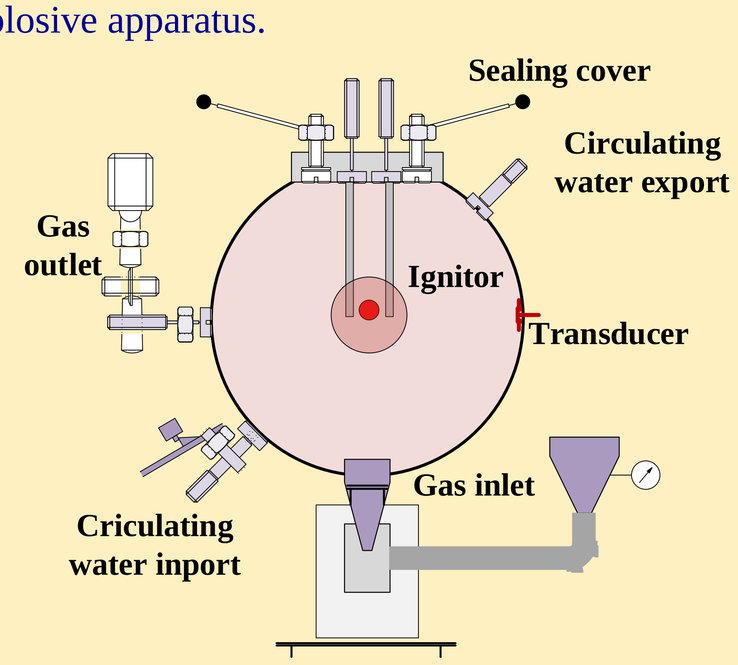

Fig. 2 *Spherical explosive apparatus*

- The results can be applied in optimizing the additives selection from large quantities of combustible substances (gases and liquids.
- The chemical composition of the explosion products is necessary to be measured to provide a basis for designs for the corresponding power generating equipment.

Conception of explosion power generation system

The explosion experiments on the lower explosive limit, ignition energy and the pressure characteristics, etc. of the dilute methane/additives are conducted in spherical explosive apparatus.

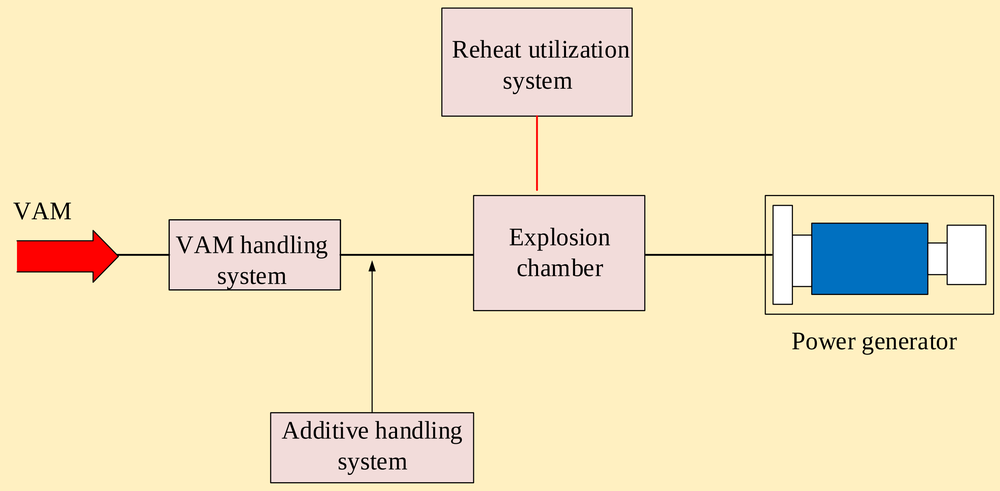

Fig. 3 *Conception of explosion power generation*

Conclusions

- The explosion power generation is a kind of novel and promising method, and the feasibility of this method is analyzed from theoretical analysis and experimental analysis.
- The additives to low concentration methane are selected from large quantities of combustible substances by theoretical analysis, especially the costs analysis. To verify the above-mentioned theoretical analysis, a considerable number of fundamental experiments will be conducted systematically, and the series of experiments can provide a basis for the corresponding power generating equipment design.
- It is foreseeable that the realization of the explosion power generation system will bring practical and widespread implementation

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