

Study on influence of gas content of coal and gas outburst

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Abstract. In order to study the influence of gas content on the strength of coal and gas outburst, a set of device for simulating coal and gas outburst is improved by adding flowmeter and gas pressure sensors. The simulation experiments of coal and gas outburst were carried out with gas content of 7.5m³/t, 8.0m³/t, 8.5m³/t and 9.0m³/t respectively. The test results show that with the increase of gas content, the weight of outburst coal and the outburst distance increases gradually, the variation trend of crushing is not obvious either. Introduction

1. Introduction

Coal and gas outburst is a dynamic phenomenon that coal body in the front of mining face bursts into mining space with plenty of gas suddenly^[1]. It is influenced by several factors, such as ground stress, gas pressure, coal property and gas content^[2-4]. Some scholars research it by method of simulating tests^[5]. In this paper, the simulation tests of coal and Gas Outburst under different gas content are carried out to study the influence of gas content on the strength of coal and gas outburst.

2. Experiment device

2.1 Function and structure of testing device

As shown in Fig.1, The gas pressure sensor and temperature sensor are added on the basis of the original device.

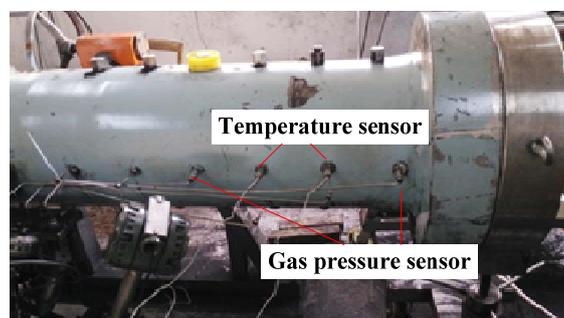


FIGURE 1. Apparatus for simulating coal and gas outburst



2.1.1 Compacting organization. The compacting organization is plunger type and the plunger is installed into side of sample cylinder. The liquid chamber is formed by plunger, cylinder wall and end cap. The coal seam is compacted by advance of plunger pushed by external high-pressure pump and its distance of travel is 400mm. As shown in Fig 2.

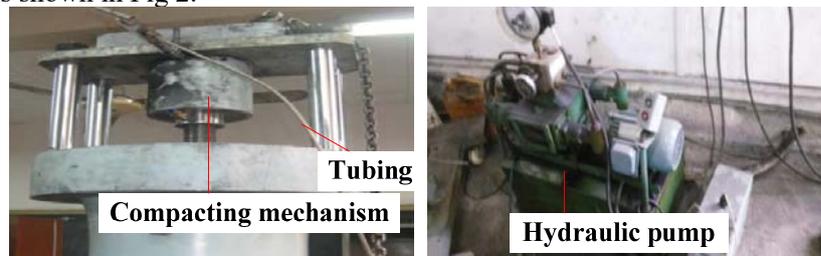


FIGURE 2. Compacting organization

2.1.2 High speed photography. This high speed 24bit CMOS camera system combines with advanced CMOS and electronic technique. The process of coal and gas outburst is transient which is less than 1s. So, high speed photography is adopted to record the outburst phenomenon. In the test, it is initiated before the outburst is induced and thus outburst process can be recorded, which is shown in Fig 3.

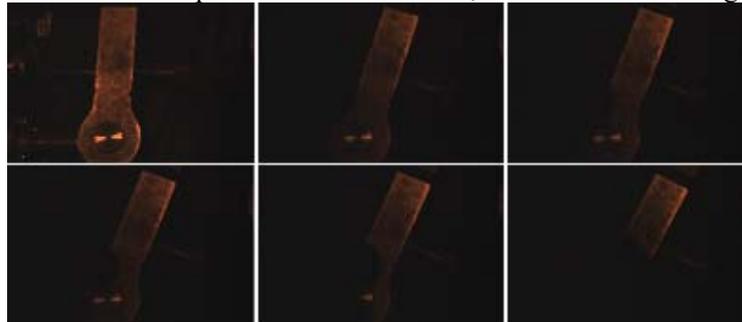


FIGURE 3. Coal and gas outburst

2.1.3 Gas meter and gas flowmeter. The gas flow is measured by flowmeter. However, its usage range is smaller than 0.3MPa. Thus, the flow of gas is calculated according to the volume of gas bottle multiplying change of gas pressure.

$$V_0 = P_1 V_1 T_0 / P_0 T_1 \quad (1)$$

Where:

- Pressure under standard atmospheric condition ($P_0 = 101.325 \text{KPa} = 0.101325 \text{MPa}$);
- Temperature under standard atmospheric condition ($T_0 = 20^\circ \text{C} = 293.15 \text{K}$);
- Gas volume under standard atmospheric condition (m^3);
- Pressure under current condition (MPa);
- Temperature under current condition (K);
- Gas volume under current condition (m^3).

According to equation(1), the gas volumes under standard atmospheric condition before and after coal's adsorption of gas are obtained and the gas is exactly gas content of coal. Besides, while the pressure is 0.25MPa, its error rate is 0.2% compared to the value measured by flowmeter, demonstrating its feasibility.

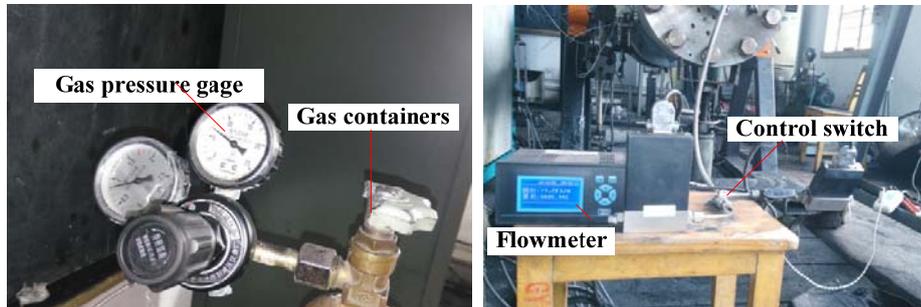


FIGURE 4. pressure gauge and flowmeter

3. Simulating test of coal and gas outburst

3.1 Experiment scheme

Grain size distribution of coal specimen is displayed in table 1 below.

TABLE 1. Grain size distribution of coal specimen

	<0.75mm	0.75mm~1.6mm	1.6mm~2.5mm	2.5mm~5.0mm
Mass percent/%	9	38	29	24

3.2 Experiment

The testing results is shown in table 2.

TABLE 2. Parameters in influence of ground stress on outburst experiment

NO	Ground stress/MPa	Gas content/m ³ /t	Outburst caliber/mm	Moisture content/%	Total coal weight/Kg	Outburst condition	Outburst intensity/Kg
1	15	7.5	50	1.5	64.4	Outburst	25.9
2	15	8.0	50	1.5	64.2	Outburst	26.0
3	15	8.5	50	1.5	64.5	Outburst	26.5
4	15	9.0	50	1.5	64.7	Outburst	27.0

3.3 regional and particle size distribution of coal

The collecting apparatus of outburst coal sample divides outburst zone into 5 parts.

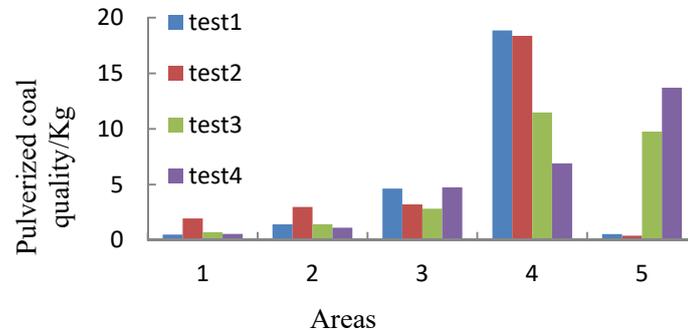


FIGURE 5.Weight distribution after coal and gas outburst

From fig.5, the gas content has obvious influence on the intensity of coal and gas outburst. The weights of outburst coal in tests 1~4 are 25.9Kg, 26.0Kg, 26.5Kg, 27.0Kg respectively. With the increase of gas content, the outburst strength is increasing, and the influence of gas content on the intensity of coal and gas outburst is nonlinear.

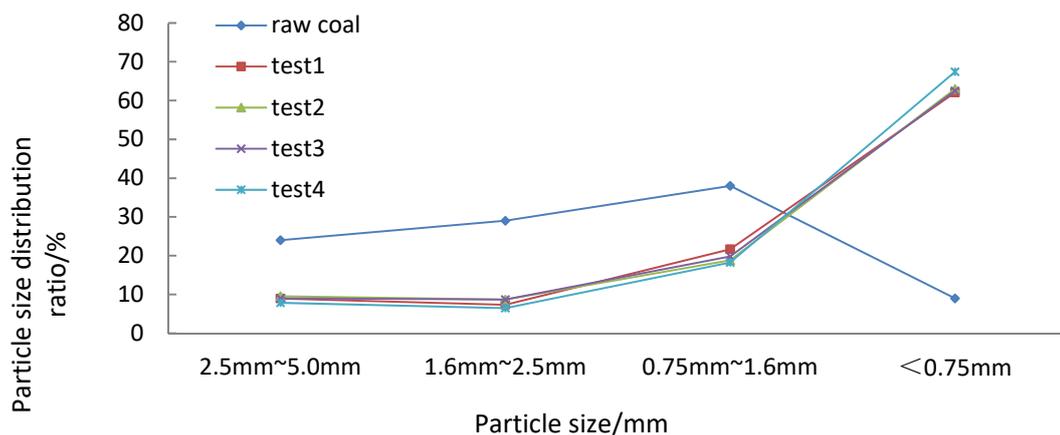


FIGURE 6.Comparison of grain size before and after outburst

Comparison of coal's grain size before and after outburst is shown in fig.6. Generally speaking, the proportion of bigger grain size decreases in coal sample after outburst while the smaller one rises up correspondingly, showing strong crushing property. The reason of coal's crushing during outburst is that the absorbed gas in porous particle desorbs into free gas, contributing to a pressure gap of gas inside and outside particle during swelling process. Besides, the crushing effect is stronger while the effect of gas swelling on coal sample is more evident^[8-10]. Under conditions that underground stress and outburst caliber remain the same, the outburst distance and intensity rise up with increase of gas content. However, the change is not prominent and the variation trend of crushing is not obvious.

4. Conclusion

1) Other test conditions remain unchanged, With the increase of gas content, the quality of outburst coal body increases with the increase of gas pressure, but the quality of outburst coal body is relatively close.

2) With the increase of gas content, the outburst distance of coal sample increases and the outburst strength increases, but the change is not obvious, and the tendency of pulverization is not obvious.

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