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Study on the Spatiotemporal Response Characteristics of Effective Discharge Radius of Bedding Drilling

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Abstract

In order to reduce the gas hazard in coal seams and effectively discharge gas at local locations, a new method of drilling cuttings volume and gas desorption index method was used for field measurement, and numerical simulation was used to study the effective discharge radius of bedding drilling at different discharge times and different apertures. Changes under the influence. The determination basis and method of the new drilling cuttings index method are expounded in detail, and the industrial test is carried out in Xiaoxi Coal Mine, Shanxi. For the discharge boreholes of the aperture, the effective discharge radius increases with the increase of the discharge time within a certain period of time; for the discharge boreholes of the same discharge time, the effective discharge radius increases with the increase of the aperture.

Keywords

Local outburst prevention, new cuttings index method, effective discharge radius, spatiotemporal response characteristics, numerical simulation

Introduction

According to the "Detailed Rules for the Prevention and Control of Coal and Gas outburst", the outburst mine shall formulate and adopt regional and local outburst prevention plans according to the situation of the mine [1-3]. Advanced discharge drilling is a widely used local outburst prevention measure in outburst mine, and the effective discharge radius of drilling is an important basis for discharge drilling design [4].

In order to effectively avoid drilling spacing and discharge blank belt, drilling spacing is too small and increase engineering, from different discharge time and different aperture to investigate drilling discharge capacity, make the drilling effective discharge radius determination more intuitive and targeted, this paper proposed a new drill dust and drill chip gas desorption index method, and combined with the numerical simulation of the drilling effective discharge radius response characteristics, the results of small coal mine advanced discharge drilling design [5-8].

1. New drilling chip index method

At present, the effective impact radius of discharge drilling drilling has the advantages of intuitive and targeted, the application is more common, but the construction period is long, the hole expansion is easy to affect the accuracy of the test results, and can not get the effective impact radius of discharge drilling in different discharge time [9-12].

New drilling chip index method is in the given drilling diameter, natural discharge conditions, for different discharge time of gas discharge around drilling coal drilling chip S value and drilling chip gas desorption index K1 value measured, comprehensively determine the discharge of drilling around coal S value and K1 value reduced to the safety allowable value of the area radius, namely the effective emission radius [13-17]. The effective influence radius of the discharge drilling hole at different discharge times can be obtained directly, so as to provide a reasonable basis for the reasonable borehole spacing design of the local outburst prevention measures of the advanced discharge drilling hole [18-20].

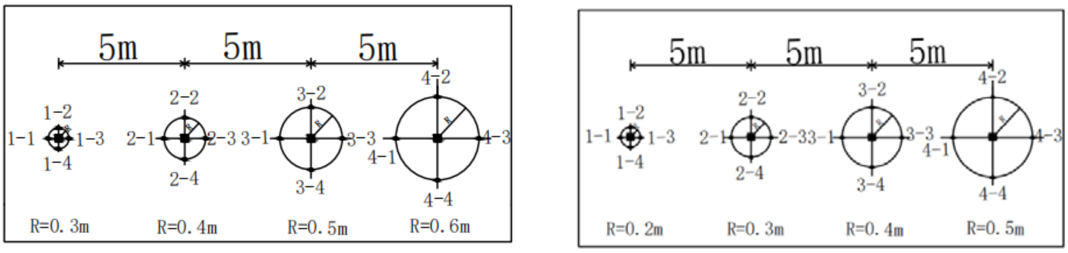
2. Field measurement

2.1 Drilling arrangement

The test site is selected to determine the effective discharge radius of Φ75 mm borehole at 786 m in 3106, Xiaoxi Coal Mine and Φ42 mm borehole at 642 m of 3106.

The first set of tests constructed four discharge holes of 75 mm diameter and 15 m depth with 5 m spacing between two adjacent discharge holes; four 42 mm diameter hole test holes of about 0.3 m, 0.4 m, 0.5 m and 0.6 m respectively.

The second set of tests constructed four test holes of 42 mm and 15 m with two adjacent discharge holes of 5 m; four test holes with 42 mm around each test hole, and the test holes and discharge hole of 0.2 m, 0.3 m, 0.4 m and 0.5 m respectively. The drill hole arrangement is shown in Figure 1.



(a) Φ75mm Test drill layout (b) Φ42mm Test drill layout

Figure 1. Layout diagram of drilling hole for testing effective drainage radius of bedding drilling.

2.2 75 mm discharge borehole effectively impact radius determination

According to the above method, the effective discharge gas radius of Φ75 mm downstream drilling was tested at the lane at 786 m of main lane 3106.

According to the measured data of the test drilling cuttings and the drilling chip desorption index of the Φ75 mm discharge boreholes at different discharge times, it can be concluded that:

(1) With the increase of the emission time, the drill chip gas desorption index measured by the test borehole is getting smaller and smaller;

(2) When the discharge time is 2 h, the K1 value at all test boreholes of 6 m, 8 m and 10 m exceeds the critical value (K1=0.5);

(3) When the discharge time is 4 h, the K1 value of the test hole 0.3 m and 0.4 m from the discharge hole has decreased below 0.5, but the K1 value of the test hole 0.5 m and 0.6 m from the discharge hole still exceeds the standard, that is, the K1 value is above 0.5;

(4) When the discharge time is 6 h, the K1 value of the test hole 0.3 m, 0.4 m, 0.4 m and 0.5 m away from the discharge hole has dropped below 0.5, but the K1 value of the test hole 0.6 m away from the discharge hole exceeds the standard;

(5) When the discharge time reaches 8 h, the K1 value of the test borehole 0.3 m, 0.4 m and 0.5 m away from the discharge hole drops below 0.5, but the K1 value of the test borehole 0.6m away from the discharge hole still exceeds the standard.

2.3 42mm discharge borehole effective impact radius determination

According to the above method, the effective discharge gas radius of the Φ42 mm downstream drilling hole was tested at 642 m in the main lane of 3106.

According to the measured data of the test drilling chip amount and drilling chip desorption index of the Φ42 mm discharge borehole at different discharge times, it can be concluded that:

(1) With the increase of the emission time, the drill chip gas desorption index measured by the test borehole is getting smaller and smaller;

(2) At the discharge time of 2 h, the K1 value of all the test boreholes at 6 m, 8 m and 10 m exceeds the critical value (K1=0.5);

(3) When the discharge time is 4 h, the K1 value of the test hole 0.2 m from the discharge hole has decreased below 0.5, but the K1 value of the test hole 0.3 m, 0.4 m and 0.5 m from the discharge hole is still exceeding the standard, that is, the K1 value is above 0.5;

(4) When the discharge time is 6 h, the K1 value of the test hole 0.2 m, 0.3 m, 0.3 m and 0.4 m from the discharge

hole has dropped below 0.5, but the K1 value of the test hole 0.5 m from the discharge hole exceeds the standard;

(5) When the discharge time reaches 8 h, the K1 value of the test hole 0.2 m, 0.3 m and 0.4 m from the discharge hole drops below 0.5, but the test hole 0.5 m from the discharge hole still exceeds the K1 value at the depth of 8 m and 10 m.

3. Conclusion

(1) The new drill chip index method can intuitively obtain the effective influence radius of discharge borehole at different discharge times, and study the effective influence radius of discharge borehole from different pore sizes and different discharge times.

(2) In the discharge time, at 2h, 4h, 6h and 8h, the effective impact radius of 75mm diameter drilling is 0.25m, 0.46m, 0.53m and 0.58m, and 42mm diameter hole is 0.18m,0.27m,0.41m and 0.46m.

With the same aperture, the effective impact radius increases with the increase of the discharge time, and the effective impact radius increases with the drilling aperture.

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