Coalmine Green Mining with Gangue Backfilling Technique

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Abstract

Gangue backfilling can solve the environmental pollution caused by open accumulation of gangue while significantly reducing the amount of ground settlement great value for green mining. First, using the owe design test equipment to test the mechanical properties of coal gangue; Then, according to the mechanical properties of coal gangue to improve and design the backfilling equipment; Finally, by monitoring the effect of gangue backfilling to improve backfilling technique. Through doing these works to Improve and optimize the efficiency of gangue backfilling green mining technology, solving a series of open-air environment pollution caused by open accumulation of gangue.

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1 Introduction

At present, environmental pollution and resource waste problems are more serious in coal industry. According to statistics, the annual emissions of coal mine gangue about 3.5 billion ton. Gangue emissions occupy a lot of land resources, but also serious pollution of air and groundwater, and even there is risk of gangue dump explosion.
Gangue backfilling mining technology is one of the green mining technologies to solve coal gangue emissions occupy land resources problems. However, in current circumstances, there are many backfilling mining technology needing to be further solved and improved: such as development of backfilling equipment, backfilling material’s delivery and optimization of existing backfilling equipments.

Many scholars in this area have done a study about related issues. Paper 1 takes use of coal gangue and other solid waste, work out a range of mining methods and key technologies. Sun Xikui and Li Xuehua research filling roadway’s layout location, amounts, and the stability of the overlying rock, these results are widely applied in specific mines and achieving remarkable results. In foreign countries, L. Piciacchia et al carried out gangue filling of mined areas, and proposed a variety of related technologies and theories. Through improving the gangue backfilling equipment design to optimize the gangue backfilling technology, making gangue backfilling technology more highly efficient, more energy saving, more environmental protection.

2 Broken rock compaction test

The test apparatus designed by ourselves, the United MTS810 servo-mechanical testing machine to test. The device is ‘Broken rock compaction permeameter, shown as fig.2.

In the natural state, the gangue is mixture with different sizes. In practical applications, there is a very important problem of the gangue grading, so need to study how particle size of gangue to effect mechanical properties of gangue. First, rock samples were graded according to different size, as: size1(20~25mm), size 2(15~20mm), size 3(10~15mm), size 4(5~10mm), size 5(2.5~5mm), size 6(0~2.5mm), and using g1, g2, g3, g4, g5, g6, to express. Test the backfilling gangue directly. The results shown in Fig.3.
It can be seen from Figure 3: When axial stress is small, a large increase in gangue strain. With the pressure increases, slowing the increase in gangue strain, gradually moving to stable. As gangue axial stress increasing, swell factor decreasing; In the initial stage of pressure, swell factor has large reduction. With the increase of axial stress, waste gangue swell factor decreasing slowly and gradually tending to stability.

3 Design of gangue backfilling equipment

(1) Gangue backfilling automatic contraction machine: By improving the drain gangue hole’s size and spacing to achieve good backfilling effect. Machine specific design parameters: Pattern is SGB-40T/55; Motor Power is 55 KW; Transport capacity is 200 t/h; Intermediate tank size is $1500 \times 630 \times 270$ mm; Drain gangue hole size is $500 \times 400$ mm.

(2) Gangue crushing machine: Through installing gangue crushing between car dumper and gangue scraper conveyor to optimize the gangue fragmentation, in order to enhance the backfilling effect. Machine specific design parameters: Pattern is PE-500 $\times 750$; Motor Power is 45 KW; Crushing capacity is $30 \sim 80$ t/h; Feeding hole size is $500 \times 700$ mm; Discharge opening set range is $50 \sim 120$ mm; Maximum feeding hole grading is 400 mm.

(3) Contraction belt conveyor: Through calculation to install belt conveyor drive in the middle of contraction belt conveyor. Contraction belt conveyor’s transport capacity is 137.5 t/h before altering the machine, Contraction belt conveyor’s transport capacity is 400 t/h after altering the machine, can meet the transportation requirements. Machine specific design parameters: Pattern is SD-800/2 $\times 75$ KW; Motor Power is $2 \times 75$ KW; Transport capacity is 400 t/h; Belt width is 800 mm; Belt speed is 2 m/s; Reservoir belt length is 100 m.

(4) Backfilling hydraulic support design: After much research and analysis, coal academies designed the backfilling hydraulic support for gangue backfilling. Machine specific design parameters: Pattern is ZZ2600/13/20.5BC. Working resistance is 2600 KN. Initial support force is 1812 KN. Transport length is 3690mm. Working height is 1500 mm. Width is 1500 mm. Support intensity is 0.45 MPa. As shown in fig.4.
4 Pressure law analysis of gangue backfilling face

4.1 Analysis for the quality of hydraulic support

We can see from fig.5. After filling of mined areas, initial working resistance and maximum working resistance of hydraulic support has significantly reduced, that work face’s roof has been controlled effective, reduced movement of the roof. Hydraulic support in stage of constant resistance, resistance tends to stabilize, so column pressure will not exceed the rated working resistance, column does not appear open the valve phenomena, column safety valve did not open. Through the monitoring data and field observations data that, work face didn’t has no obvious periodic pressure.

4.2 Analysis of the tunnel’s deformation

We can see from fig.6, after filling of mined areas, mined areas roadway’s roof and floor, and two groups’ amount of displacement significantly reduced. Gangue backfilling control the movement of mined areas’ roof, weakened the roof moving effect on the work face’s two lane, increased safety coefficient of production.
5 Conclusion

(1) Gangue backfilling mining coal technology uses gangue backfilling to control rock’s movement, effectively controls the rock collapse and surface subsidence, reduce security risks. Protecting the building, so as to maintain coalmine stable, easing the contradiction between the industry and agriculture.

(2) Gangue backfilling mining coal technology can prevent the accumulation of gangue dump on the ground to occupy plough land, eliminating the gangue to pollute natural environment and damage earth's surface, truly realizing the coordinated development of resources and the environment.

References


