

Case Study 2 Underground Fracturing Permeability Increase and Outburst Elimination Technology in Gassy Coal Mine and Outburst Coal Mine in China

Initial condition:

Hebi No.6 Coal Mine is a coal and gas outburst coal mine. The minable coal seam is Shanxi Formation 2₁ coal seam, the consistent coefficient is $f=1$. The thickness of coal seam is 4.72~13.51m. According to the evaluation result of H.B.M.D.L.B.[2005] No. 155 of Hebi Coal Power Co., Ltd., “2005 Gas Grade and Carbon Dioxide Evaluation Report of No. 6 coal mine”, the absolute gas emission is 63.23m³/min, the relative gas emission is 25.07m³/t.

Gas treatment:

The gas pressure in coal seam of Hebi No. 6 Coal Mine is high, and the risk of gas outburst is huge. Therefore it is necessary to conduct pre-drainage in advance to ensure safety drivage. In addition, the coal seam permeability of the coal mine is low, the extraction period is long, the monthly average drivage is just 12.26m, the over standard rate is 35%, serious outburst accident once happened in the drivage period, and the outburst of coal and gas has become a critical obstacle for the normal relay of extraction areas.

Solution:

It is suggested to use extraction and discharge by source and section in to drivage end to extract gas comprehensively (refer to Fig.1), apply underground hydraulic fracture system to fracture the coal seam once the gas extraction hole formed, with the purpose to increase the permeability of coal seam, which provide sufficient time for rapid drivage and form fracture rapid drivage mode. 114 extraction holes have been constructed after the fracture, the total length of extraction holes is about 7810m, and the gas extraction output during this period is 720,000m³, the total length of drivage is over 400m and inspected for 142 times, the over standard rate is 3.2%, and the average monthly progress is around 40m. Compared with the measures of advance

drainage borehole for the roadway, the drivage speed improved 2.26 times.

The gas extraction boreholes are drilled in the upper channel and down channel of roadway in 2115 working face (refer to Fig.2, both of the upper channel and down channel of roadway shall be 10m), the coal seam is fractured by hydraulic fracture system (refer to Fig.3), and succeeded for 6 times. The permeability of coal seam in 2115 working face improved after fracture, the time needed for coal mine gas extraction has been reduced significantly, and the gas extraction and discharge quantity for every hundred meter drill reached $313.5\text{m}^3/\text{d}$. According to the measured gas extraction data, the total gas quantity extracted is $223.05 \times 10^4\text{m}^3$, which accounts for 35% of the gas reserves of the entire working face, please refer to table 1 for the specific extraction result.

This technology demonstrates the unique technical advantage for single coal seam and coal seam with low permeability and difficult to extract. With this technology, it is able to extract and utilize the gas underground, turn the hazard into benefit, turn the waste into wealth, and establish a new path and new process to treat gas in coal seam with low permeability and no protection layer.

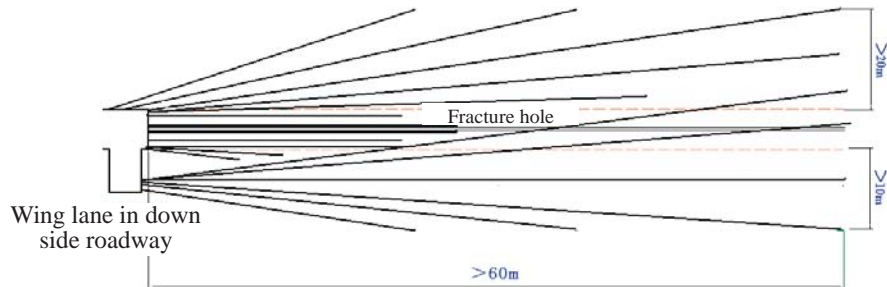


Fig. 1 Hydraulic Fracture Extraction System for Drivage Working Face

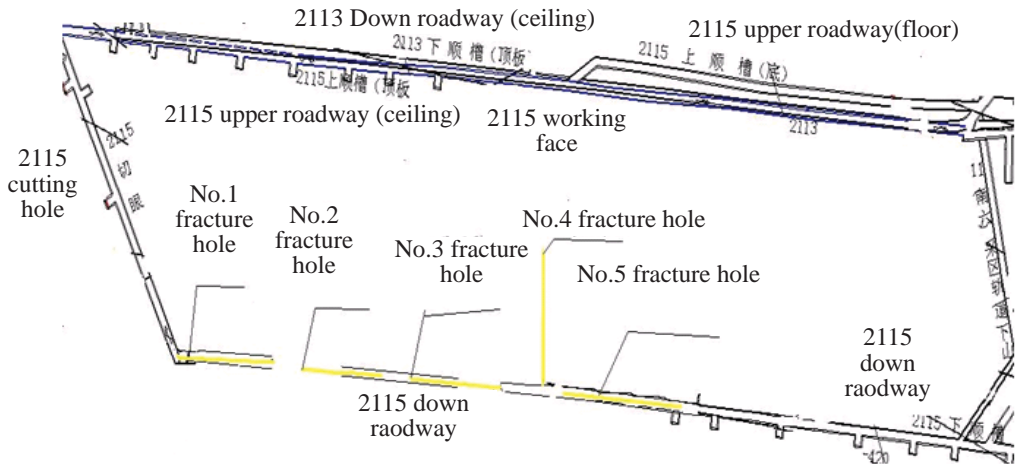


Fig.2 Arrangement of fracture system to increase permeability in 2115 working face

Table 1 Comparison of 2115 working face before and after underground fracture to increase permeability

	Permeability coefficient (md)	Gas flow decay coefficient (d ⁻¹)	Gas flow in single hole per hundred meter (m ³ /d.hm)	Monthly progress (m)	Over standard rate %
Before fracture	0.03~0.045	0.3871	26.52	12.26	35
After fracture	5.83	0.044	573.7	40	3.2
Time of improvement	129~194	8.80	21.62	3.3	10.9

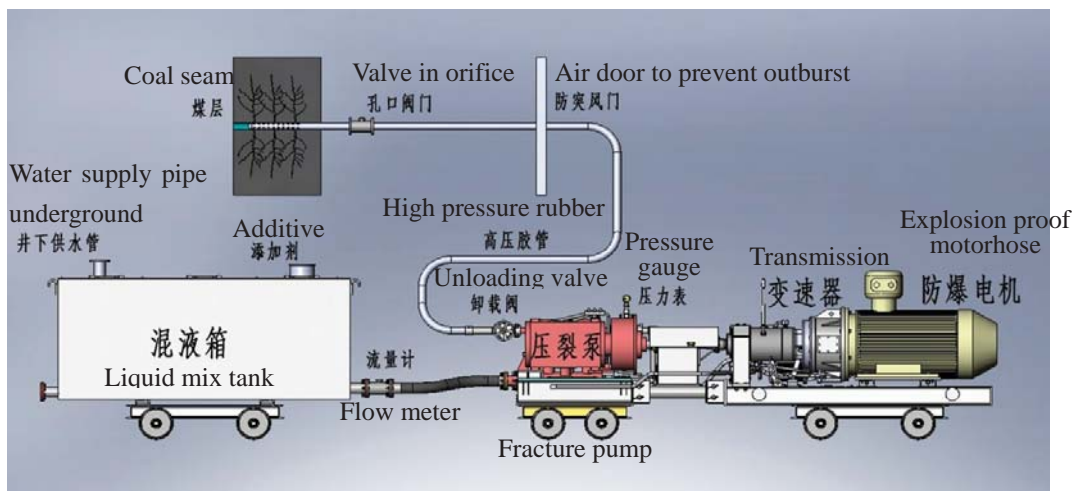


Fig. 3 Diagram of fracture equipment system