Discussion on Some Problems of Regulations and Standards of Coal Industry

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Abstract: In order to ensure the safety and health of the coal mine safety production and personnel, the state had issued a variety of laws and regulations and industry standards. Coal mining enterprises must abide by these laws and regulations. However, due to the fuzzy or inconsistent conditions of individual clauses, these regulations and industry norms lead to various problems in the actual production practice of coal mines. Combining with coal mine production practice, several issues such as the definition of coal and gas outburst, gas drainage standards and pore pressure measurement in tunnelling face, this paper puts forward some suggestions on the revision of the rules and standards for the specific industries of coal mine, which will provide reference for the revision of the rules and standards in the future.

1. Introduction
Gas problem has been one of the main bottlenecks restricting the safety production of high gas outburst mine. In recent years, with the continuous development of gas control and outburst prevention technology, some new management concepts and new technical equipment continue to emerge, which plays an important role in the gas control of high gas outburst mines. Therefore, the state combines these new technologies, equipment and concepts, and constantly modifies and improves some laws and regulations and standards of the coal industry to adapt to various new situations.

Although these industrial laws and regulations and relevant standards are widely consulted by social experts and scholars when they are revised and improved, the author believes that there are still deficiencies. In the actual operation of these industry regulations and standards, there are often some problems, either because the terms are relatively general, which makes it difficult to understand, or because the terms are inconsistent. Based on the long-term field practice in coal mine, the author discusses and studies several problems worthy of discussion in the coal industry laws and regulations and relevant standards, aiming to provide reference and reference for the revision of future norms, regulations and industry standards.

2. Definition of coal and gas outburst danger

2.1. Problem raised
According to Article 115 of coal mine safety regulations (2016) [1], if the coal seam is in danger of outburst, it is strictly prohibited to use caving coal mining; Article 152 stipulates that if the coal seam dip angle is greater than 12°, it is strictly prohibited to use downward ventilation if there is danger of
outburst.

In the above two clauses, the concept of prominent danger is involved, but the definition of prominent danger is relatively vague, which has also caused many experts and scholars' controversy.

2.2. Problem analysis

Article 53 of provisions on prevention and control of coal and gas outburst [2]: "when inspecting the outburst prevention measures in the area of pre drainage coal seam gas, it shall be judged according to the critical value determined through test and investigation. Before determining, it can be judged according to the following indexes: if the residual gas pressure or residual gas content index is used for inspection, the residual gas pressure of coal seam is less than 0.74MPa or the pre pumping area with the content less than 8 cubic meter per ton is no outburst danger area ".

According to the relevant interpretation of the "provisions on prevention and control of coal and gas outburst" [3], it can be considered that the coal seam is no longer in danger of outburst after taking regional outburst prevention measures and passing the effect inspection. That is to say, the coal mining method of caving can be adopted, and the downward ventilation can also be adopted.

However, in the actual mining activities of outburst mines, there are many examples of coal and gas outburst after taking regional measures and passing the inspection. For example, Sihe Coal Mine of Shanxi Coal Group has a major coal and gas outburst accident in the process of driving a coal lane. The accident investigation report shows that although the "four in one" regional comprehensive outburst prevention measures have been taken before the tunneling of the tunnel, and the gas content will be below the critical value, the geological structure in front of the working face is relatively developed, and there are soft layers, and the effect test of regional measures can not reflect the situation, which leads to the occurrence of the accident.

The author believes that although the outburst control measures have been taken and the effect has been tested, the test belongs to the test of sampling nature. Only when the gas occurrence of the tested coal seam is very stable, the test results can represent the outburst risk of the whole test area. If there are undetected geological structures or other conditions, the coal seam still has outburst risk. This is the reason why the "Regulations on prevention and control of coal and gas outburst" requires regional verification.

2.3. Suggestions for modification of regulations

Therefore, with regard to the relevant clauses in Article 115 and Article 152 of the coal mine safety regulations, the author suggests that they should be revised as follows: "it is strictly prohibited to use caving coal mining in outburst coal seam", "it is strictly prohibited to use downward ventilation in outburst coal seam working face with coal seam inclination greater than 12°.

3. Evaluation on the standard of extraction in driving face

3.1. Problem raised

In 2012, the State administration of work safety, the National Development and Reform Commission, the State Energy Administration and the State Administration of coal mine safety issued the Interim Provisions on coal mine gas drainage standards [4].

Among them, the seventh provision: a driving face absolute gas emission is more than 3 cubic meter per minute, must be gas extraction. Article 29: when the wind speed of the mining face is not more than 4 meter per second and the gas concentration in the return air flow is less than 1%, the gas drainage effect of the mining face shall be determined to be up to the standard.

Article 7 specifies whether the pumping is required, while Article 29 specifies whether the pumping is up to the standard. However, in the actual driving process of coal mine, there are often two contradictory situations. For example, in a high gas mine, a 25 square meters coal roadway driving face has a return air volume of 1000 cubic meter per minute and a gas emission volume of 4 cubic meter per minute.
3.2. Problem analysis
According to the requirements of Article 7, if the gas emission of the coal roadway is more than 3 cubic meter per minute, gas extraction must be carried out. The conditions for determining the standard of gas extraction are that the wind speed of the working face does not exceed 4 meter per second and the gas concentration in the return air flow is less than 1%. However, according to the return air volume of the working face, the wind speed is 0.67 meter per second. According to the calculation of the gas emission volume of the working face, the gas concentration of the return air flow is 0.4%, which has met the requirements of standard extraction. That is to say, the working face can reach the standard without gas drainage, which shows that article 7 and Article 29 of the interim provisions on coal mine gas drainage meet the standard are contradictory.

3.3. Suggestions for modification of regulations
Therefore, the author suggests that the seventh article should be revised as follows: when the gas emission in the driving face is more than 3 cubic meter per minute, and the problem of gas cannot be solved by air drainage, gas drainage must be carried out.

4. Measurement of gas pressure in downward drilling

4.1. Problem raised
Gas pressure of coal seam is one of the important parameters of gas. To accurately grasp gas pressure of coal seam is an important basis for studying gas reserves, gas emission and outburst risk. However, due to the restriction of the conditions of the well and the roadway, in the process of gas pressure measurement, downward pressure drilling is often encountered. The commonly used sealing methods of downward pressure drilling are yellow mud, cement slurry, rubber bag, etc. These methods can basically accurately measure the gas pressure of coal seam under the condition that the coal seam is relatively stable, there is no large geological structure and there is no drilling water [5-7].

However, during the drilling, back drilling and hole sealing of downward pressure measuring borehole, there is often water accumulation in the borehole. In addition, the water seepage in the rock stratum leads to more water accumulation in the borehole. The existence of these water in the borehole certainly has different degrees of impact on the measurement of coal seam gas pressure. The gas pressure presented by the pressure gauge does not really reflect the gas pressure of the measured coal seam. However, many researchers and practitioners have different opinions on whether the downward drilling gas pressure needs to be corrected, which is not easy to be concluded [8,9].

Article 8.4.2 of the industry standard direct measurement method of coal seam gas pressure in coal mine (AQ/T1047-2007) [10] issued by the State Administration of work safety stipulates that when the pressure measurement work is finished and the head is removed, the water discharged from the borehole shall be measured, and the influence of the drilling water on the measurement result shall be corrected. The correction method can be based on the water discharged from the borehole Quantity, drilling parameters, sealing parameters, etc., among which, horizontal and downward pressure drilling is not modified.

4.2. Problem analysis
The author thinks that the drilling water (except the confined water) has certain influence on the downward pressure drilling, and the following water bearing pressure drilling is analyzed as an example:

Fig. 1 is the schematic diagram of the downward water bearing pressure test drilling, and there is a certain amount of drilling water in the pressure pipe. After the pressure gauge is stable, the pressure in the piezometer is composed of gas chamber pressure, water pressure and gas pressure, forming a balanced state. The gas pressure of coal seam should be the sum of gauge pressure and drilling water pressure. That is:

\[ P = P_1 + \rho g h \]  (1)
Figure 1 Schematic diagram of downward water pressure drilling

Where $P_1$ is gauge pressure, $P$ is coal seam gas pressure, $H$ is water level of drilling water.

In this case, if it is a downward deep drilling, the drilling water pressure will be very large, and the pressure displayed by the pressure gauge is far from the real gas pressure of the coal seam.

But for the down hole, it is not convenient to measure the water level in the piezometric pipe, which makes it difficult to determine the water pressure in the hole. Especially in the down deep drilling, the water pressure is often very large. If the pressure pipe is full of drilling water, the drilling water pressure can be accurately determined.

Many domestic scholars have reduced the influence of drilling water on gas pressure measurement to a certain extent through pressure recovery [11], water plugging by running casing [12], setting drainage pipes and other measures [13-15], and achieved certain results, which is also the follow-up research direction of measuring coal seam gas pressure by down water cut drilling.

4.3. Suggestions for standard modification

Therefore, it is suggested that the relevant clauses of the direct measurement method of coal seam gas pressure in coal mine (AQ/t1047-2007) on the pressure measurement of water bearing borehole in the downward direction should be amended as follows: the pressure water and the water accumulated in the borehole should be avoided as much as possible. If there is water accumulated, the amount of water accumulated should be controlled as much as possible, and the proven effective method can also be used to correct the gas pressure.

5. Conclusion

5.1. It is suggested that the relevant clauses in Article 115 and Article 152 of the coal mine safety regulations should be revised as: "It is strictly prohibited to adopt caving mining in outburst coal seam", "it is strictly prohibited to adopt downward ventilation in outburst coal seam working face with coal seam inclination greater than $12^\circ$.

5.2. It is suggested that article 7 of the Interim Provisions on the standard of gas drainage in coal mines should be revised as follows: when the gas emission in the driving face exceeds 3 cubic meter per minute, and the gas problem cannot be solved only by air drainage, gas drainage must be carried out.

5.3. It is suggested that the relevant clauses in the direct measurement method of coal seam gas pressure in coal mine (AQ/T1047-2007) on the pressure measurement of water bearing borehole in the downward direction should be amended as follows: the pressure water and water accumulation in the
borehole should be avoided as much as possible in the downward direction. If there is water accumulation, the amount of water accumulation should be controlled as much as possible, and the proven effective method can also be used to correct the gas pressure.

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