Analysis and research on coal quality in Hetaoyu coal mine

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Abstract. In this paper, industrial analysis and element analysis were used to determine the quality of coal after the determination of various indicators, then hetaoyu coal quality was determined. It is found that the coal in this area is characterized by extremely low total moisture, low ash, medium and high volatile content, high calorific value, high caloric value, and low sulfur content. It is beneficial to realize the comprehensive utilization of clean, efficient, low-carbon and energy-saving coal.

Key words: Coal quality; Analytical investigation; Walnut bath.

1. Introduction
With the rapid development of China’s market economy, the development of the coal industry should also change. In recent years, China has been promoting the development of clean energy, and the alternative energy of coal has increased. Therefore, the demand of coal industry is not as urgent as in the past [1]. Therefore, we should pursue clean and efficient utilization of coal. The area I live in is located in Qingyang, Gansu Province, in which the coal reserves in hetaoyu mining area are very rich. We should also make corresponding changes and take the road of clean and efficient utilization and development of coal. In order to solve the above urgent problems, we should make a reasonable plan to study and analyze the coal quality of hetaoyu coal mine (including the calorific value, moisture, ash, sulfur, etc.) to achieve efficient and clean development and utilization of hetaoyu coal mine [2].

1.1. The formation and development of Qingyang coal
The northwest of Qingyang area where I live is the west margin fault fold belt of Ordos. The fault is connected with fold belt, and the preservation of coal measure strata is closely related to geological structure movement and later denudation. Due to the undulation of the bottom of the formed coal, generally speaking, there are thick coal deposits in the low-lying areas, while in the uplifted areas, the coal seams become thinner. If efficient and clean utilization of Qingyang coal is achieved, Qingyang coal is not only conducive to sustainable development, but also go further and wider. Qingyang economy will also be driven by coal, and Qingyang will become famous from then on [3].

1.2. Research status of coal quality analysis
As for the current situation of coal quality analysis and research in China, a large number of documents have been consulted and combed in HowNet and other network media. Mainly inquired about the coal calorific value, sulfur, volatile matter, ash melting point index research [4].
Huang Xianping, Zhao Chunpei, et al. (1999) conducted a correlation study on ash, moisture and calorific value. A bivariate first-order regression equation is established, in which the independent variable is total moisture and base ash, and the dependent variable is base low calorific value [5]. However, the research on coal quality in foreign countries is relatively early, the coal type is single and there is no coal blending phenomenon. Compared with domestic coal quality, it has obvious advantages. Generally speaking, foreign coal has the characteristics of low ash and sulfur[6].

1.3. Efficient development and utilization of coal
Clean and efficient utilization of coal is the leading direction of coal energy utilization in future life. The clean and efficient utilization of coal mainly includes two main points. The first is to improve the quality and efficiency of coal utilization, and the second is to reduce the large-scale emission of pollution waste in the process of coal utilization through "green technology". Therefore, it is essential to realize the efficient development and utilization of coal. The quality of coal we choose is particularly critical, which is a prerequisite for efficient utilization of coal.

2. Research and analysis of coal quality

2.1. theoretical basis
In the research and analysis of coal quality, first of all, we should have a theoretical understanding of coal quality analysis indexes and methods. Then according to the analysis index, the reasonable method and suitable technical means are adopted to measure and study the original coal sample. Finally, after a comprehensive understanding of the material composition, structure and characteristics of the original coal sample, we can understand the use of the coal, so we can know how to use it efficiently.

2.1.1. Main indexes of coal quality analysis. In the analysis and study of coal quality indicators, there are about 10 kinds of commonly used. The most basic indicators are moisture, ash, volatile matter, fixed carbon content, total sulfur and calorific value. These six indexes are used for routine inspection of coal quality. In addition, the maximum thickness of the resin layer, the bond index, the fusibility temperature of the coal ash, the Hardgrove grindability index and the characteristics of the coke slag are used for further comprehensive and detailed detection of coal quality [7].

2.1.2. Coal quality inspection standard. For the detection of the main indicators of coal quality, China has formulated the corresponding detection standards, and the specific corresponding relationship is shown in Table 1.

| index               | Inspection standard                                      |
|---------------------|---------------------------------------------------------|
| ash content         | Industrial analysis and determination of coal (GB / t212-2008) |
| Volatile matter     | Industrial analysis and determination of coal (GB / t212-2008) |
| Total sulfur        | Determination of total sulfur in coal (GB / t214-1996)   |
| Total moisture content | Determination of total moisture in coal (GB / t211-2017) |
| Calorific value     | Determination of calorific value of coal (GB / t213-2003) |

2.2. Analysis of coal quality of hetaoyu
In the analysis of the coal quality of hetaoyu, the specific implementation plan is implemented. The content and percentage of total moisture, ash, volatile, calorific value, fixed carbon content, coal ash fusibility, elements content and other components in coal were determined. Then, the industrial analysis is used to analyze the quality of hetaoyu coal in detail, and it is known that hetaoyu coal has good use and development space.
2.2.1. Content of coal quality test in hetaoyu. In the process of coal quality determination of hetaoyu coal, we strictly abide by the national testing standards. The correct and proper measurement methods are used to standardize the operation to ensure the maximum accuracy of the results. The specific test contents are shown in Table 2:

| Sample name          | Coalsample | Sample size | >=13mm |
|----------------------|------------|-------------|--------|
| Sample sources       | Hetaoyu coal mine | Sample quality | About 0.5kg |
| Location of detection| Coal Analysis Laboratory | environment condition | Temperature: 20 ℃ humidity: 44% |

| Testing items | Total moisture, industrial analysis, element analysis, total sulfur, calorific value, Hastelloy grindability index, coal ash fusibility, coal ash composition, mercury in coal, scour and wear index of coal, free silica in coal. |

2.2.2. Walnut Valley coal quality testing equipment. The equipment used to detect the quality of hetaoyu coal is as follows: PB5001Electronic balance, Ae200Electronic balance, sx-5-12box type electric furnace, 5E-MHG6090 blast drying oven, U-THERMmuffle furnace, CHN-628hydrocarbon nitrogen element analyzer, S19-FT sulfur detector, AC121S electronic balance, YX-HRD3000Ash fusibility tester, tas-990super hydra type atomic absorption spectrophotometer, type mercury analyzer, coal erosion and wear index meter[8].

2.2.3. Test results of coal quality of hetaoyu. The indexes of total moisture, air drying basis moisture, received basis ash, volatile matter and total sulfur of coal quality in hetaoyu coal mine were mainly detected. Test result were shown in Table 3.

| Testing items | Symol | Compay | Coal sample 1 (NC-19-0225) |
|---------------|-------|--------|----------------------------|
| Total moisture content | MT | % | 5.0 |
| Air dry basis moisture | MAd | % | 3.12 |
| Ash as received basis | AAr | % | 9.15 |
| Dry ash free volatile | VDF | % | 33.65 |
| Receipt of base carbon | CAr | % | 71.00 |
| Receipt of base hydrogen | HAr | % | 4.23 |
| Received base nitrogen | NAr | % | 0.88 |
| Receipt of base oxygen | OAr | % | 9.49 |
| Total sulfur | STAR | % | 0.25 |
| Hardgrove grindability index | HGI | / | 53 |
| Coal ash melting characteristictemperature / deformation temperature | DT ×103℃ | 1.18 |
| Erosion wear index of coal | Ke | / | 2.3 |

2.3. Analysis of coal quality in hetaoyu
Based on the industrial analysis of the data in Table 3, it can be seen that the coal quality of hetaoyu has the characteristics of ultra-low total water content, low ash content, medium high volatile content and large fixed carbon. The low water content and middle high volatile content in hetaoyu coal indicate that the coal metamorphism degree in this area has increased, which shows hetaoyu coal belongs to the type
of fat coal. If the ash content is less than 12.5%, it can be seen that the coal combustion effect in this area is good, and hetaoyu coal belongs to coking fine coal according to the coal grade. The high content of fixed carbon indicates that it has a very important use.

According to the element analysis of coal, there are polyaromatic cyclic compounds and unsaturated aliphatic hydrocarbons with carbon as the skeleton in hetaoyu coal. Of course, this is also a common feature of coal in other mining areas. This shows that the organic elements in hetaoyu coal are mainly composed of carbon, hydrogen, oxygen, nitrogen, sulfur and other elements. It can also be seen from table 3 that the coal in hetaoyu has the characteristics of high calorific value and high calorific value, as well as the characteristics of low softening temperature ash and low sulfur content. If the calorific value is large, the application effect of coal in this area is good and hetaoyu coal can be used as power fuel. The low fusibility temperature of coal ash indicates that coal ash is easy to slagging.

2.4. Comparison of coal quality between hetaoyu coal and tianshuibao coal in Huanxian County

The quality of hetaoyu coal is compared with that of tianshuibao coal in Huanxian County, and the comparison results are shown in Table 4.

| Mining area index | Hetaoyu mining area | Tianshuibao mining area |
|------------------|---------------------|------------------------|
| Total water (MT)  | Extra low           | Extra low              |
| Ash content (AD)  | Extra low           | Low                    |
| Volatile matter (Vdaf) | rising-falling   | High                   |
| Sulfur (st, d)    | Sweet               | Sulfur in              |
| Calorific value (q)| High calorific value | High calorific value   |
| Organic matter element content | low | low                  |

Through the comparison of Table 4, it can be seen that the ash and volatile components of hetaoyu are lower than those of tianshuibao, which shows that the coal quality of hetaoyu is more suitable for power fuel and power coal. The sulfur content is also slightly lower than that of tianshuibao, which indicates that the coal in hetaoyu has less pollution to the external environment. Therefore, hetaoyu coal is promising as clean fuel.

3. Development and utilization of hetaoyu coal

3.1. Application scope

After analyzing and studying the coal quality of hetaoyu coal mine, it is found that the coal is widely used. According to the excellent characteristics of coal quality, it can be summarized as the following two uses: power coal and coking coal [9].

3.2. Utilization mode

As China current economic development situation is changing from high-speed growth to high-quality development, the development of the coal industry should also change. Therefore, it has a great challenge for the coal industry. In recent years, China has also made great efforts to advocate a resource-saving society and an environment-friendly society. Qingyang hetaoyu coal should also take the road of sustainable development and realize the comprehensive utilization of clean, efficient, low-carbon, energy-saving and other aspects of coal to meet the needs of power and chemical industry.

4. Conclusion

This paper studies and analyzes the coal quality of hetaoyu coal mine. From the research and analysis of various indicators of coal quality, the coal of hetaoyu coal mine is systematically and thoroughly analyzed. At the same time, the relevant correctness conclusions are drawn, and the advantages and disadvantages of the coal quality of hetaoyu coal mine are understood. The ultimate purpose of our
analysis and research on the coal quality of hetaoyu is to realize the clean and efficient utilization of coal.

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