Quantitative analysis of coal resources in Qingyang City

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Abstract. Qingyang City is rich in coal resources, bringing great economic benefits, but also accompanied by soot-type air pollution. This paper takes hetaoyu mine and tianshiobao coal mine as the research object, and systematically analyzes the coal resources. Master the characteristics of coal quality, coal rock and coal resources. Taking the sustainable development of the green coal economy as the direction, from the source to change the current coal development process caused by the waste of resources, the deterioration of the ecological environment and environmental pollution.

Keywords: Coal resources; air pollution; efficient use; sustainable development.

1. Introduction

1.1. The Meaning of Project Research
Coal is the world’s largest and most widely distributed conventional energy source, and the cheapest energy source. Many energy experts predict that the second golden age of coal will come by the beginning of the 21st century. According to the relevant information, Qingyang City is rich in coal resources (only Huachi and Heshui County, the eastern mountains have a coal-free area), for the poor old areas have brought huge economic benefits, but also accompanied by the problem of soot-type air pollution, in order to solve this problem, effective measures must be taken to change fuel structure and improve the way coal is used, which requires the corresponding departments to deepen the research on the rational use of coal resources technology. It is important to stimulate sustainable development in the region. Therefore, quantitative analysis of the coal resources in Qingyang City is of great significance.

1.2. The research status of coal
Foreign scholars believe that the use of coal will continue to grow in the next ten years. The use of coal will inevitably lead to sulfur dioxide emissions, which will lead to carbon dioxide emissions, and thus to environmental problems such as global warming. A large number of carbon dioxide emissions have also attracted the attention of the industry, carbon capture and storage technology research and application are beginning to become important.

Some scholars also believe that the traditional coal industry has been regarded as an important source of environmental pollution, but in the next decade the use of coal in the power generation industry will continue to grow. In coal-fired power generation, for example, efficiency is an important parameter, and increasing efficiency will significantly reduce CO2 emissions. However, one of the challenges of
improving coal efficiency is the poor quality of coal, with about 45% of available coal high in moisture and ash, leading to inefficient coal use. If the problem is not solved as soon as possible, especially the quality and research analysis and efficient utilization of coal in coal, it will bring about a crisis in human life [3].

2. An overview of Qingyang coal resources

2.1. Resources reserve
Qingyang is the second largest energy city in China after the city of Yulin in Shanxi Province. According to the recent investigation and demonstration by Gansu provincial economic committee, it is proved that the total estimated reserves of coal resources in Qingyang City are 236 billion t, accounting for 96.4% of the forecast reserves in Gansu Province, accounting for 4.23% of the forecast reserves of coal resources in China. The coal-bearing area in Qingyang is about 198,000 km², and the forecast volume of domestic coal resources is 132.4 billion t, of which 19 billion t of shallow resources above kilometer, and the proven reserves are 10.4 billion t. According to the target of producing 100 million t coal per year, it can be developed for 1,000 years, and the construction conditions for hundreds of millions of tons of large coal fields have been fully met.

2.2. Coal field distribution
Qingyang is a coal resource-rich area in Gansu Province, which can be divided into 9 coal regions, and its distribution is shown in Table 1.

| Location                      | Name               | Area/km² | volume/billion t | Remarks                                |
|-------------------------------|--------------------|----------|-----------------|----------------------------------------|
| West of Heshui                | He Xi coalfield    | 94.00    | 0.932           | Carry out geological survey            |
| South of Zhengning county     | Zheng Nan coalfield| 159.00   | 1.847           | Enter the development stage            |
| Southwest of Ning county      | Ningman coalfield  | 119.00   | 1.298           | Qingyang City and Gansu Electric Co., Ltd |
| Central part of Ning County   | Ningzhong coalfield| 535.17   | 3.700           | Qingyang City and Coalfield Geological Bureau Co mining |
| West part of Huan County      | Shajingzi (middle) | 386.00   | 2.002           | China Huaneng Group Investment Company |
| Northwest of Huan County      | Tianshuibao coal field | 5.30     | 0.193          | Pingluo Wansheng coal products Co., Ltd |
| Northeast of Zhenyuan         | Zhen Bei coalfield  | 181.83   | 1.300           | Drilling operation in progress         |
| Southeast of Zheng Ning       | Luochuan coalfield | 29.79    | 0.074           | Mining of Tangshan Jiahua company      |
| Central part of Huan County   | Shajingzi (West)   | 94.00    | 0.600           | Carry out geological exploration       |

3. Hetaoyu coal mine Resources Overview
The Hetaoyu are located in the southwest of Zhengning County. The area of 191.30km² is about 15.429km east-west, 12.399km north-south, and 2116.09Mt is coal resources. Wellfields contain three seams of coal mining seams, from top to bottom number 2 coal, 5 coal, 8 coal, of which coal seam 8 coal quality for low ash, low sulfur, special low phosphorus, high thermal value of non-stick coal, can be used as thermal coal, civil coal and chemical coal.
The sample of Hetaoyu coal mine was detected by Xi’an West Thermal Boiler Environmental Engineering Co., Ltd. Whole water, industrial analysis, element analysis, full sulfur, heat generation, hashie millable index, coal ash melting, coal ash composition, coal mercury coal flushing wear index, coal free silicon dioxide, coal ash were detected, data can be found in Table 2.

**Table 2. Coal Characteristics of Hetaoyu coal mine**

| Detection                                                                 | Symbol | Company                  | Coal sample 1 (NC-19-0225) | Applicable standard |
|--------------------------------------------------------------------------|--------|--------------------------|----------------------------|---------------------|
| Total moisture content                                                   | Mt     | %                        | 5.0                        | GB/T211-2017       |
| Air dry basis moisture                                                   | Mad    | %                        | 3.12                       | GB/T212-2008       |
| Ash as received basis                                                    | Aar    | %                        | 9.15                       | DL/T568-2013       |
| Dry ash free volatile                                                   | Vdaf   | %                        | 33.65                      | GB/T214-2007       |
| Receipt of base carbon                                                   | Car    | %                        | 71.00                      | GB/T215-2008       |
| Receipt of base hydrogen                                                 | Har    | %                        | 4.23                       | GB/T216-2008       |
| Received base nitrogen                                                   | Nar    | %                        | 0.88                       | GB/T217-2008       |
| Receipt of base oxygen                                                   | Oar    | %                        | 9.49                       | GB/T218-2008       |
| Total sulfur                                                             | St. AR | %                        | 0.25                       | GB/T214-2007       |
| High calorific value of received basis                                   | Qgr, V, AR | MJ/kg                     | 28.83                      | GB/T 213-2008     |
| Low calorific value of received basis                                    | Qnet, V, AR | MJ/kg                     | 27.84                      | GB/T 213-2008     |
| Hardgrove grindability index                                             | HGI    | /                        | 53                         | GB/T2565-2014     |
| Coal ash melting characteristic temperature / deformation temperature    | DT     | 103°C                    | 1.18                       | GB/T219-2008       |
| Coal ash melting characteristic temperature / softening temperature       | ST     | 103°C                    | 1.19                       | GB/T219-2008       |
| Coal ash melting characteristic temperature / hemispherical temperature  | HT     | 103°C                    | 1.20                       | GB/T219-2008       |
| Coal ash melting characteristic temperature / flow temperature           | FT     | 103°C                    | 1.21                       | GB/T219-2008       |
| Silica in coal ash                                                       | SiO₂   | %                        | 62.56                      | GB/T1574-2007     |
| Alumina in coal ash                                                      | Al₂O₃  | %                        | 15.35                      | GB/T1574-2007     |
| Fe₂O₃ in coal ash                                                        | Fe₂O₃  | %                        | 3.23                       | GB/T1574-2007     |
| Calcium oxide in coal ash                                               | CaO    | %                        | 12.24                      | GB/T1574-2007     |
| Magnesium oxide in coal ash                                             | MgO    | %                        | 2.84                       | GB/T1574-2007     |
| Sodium oxide in coal ash                                                | Na₂O   | %                        | 0.47                       | GB/T1574-2007     |
| Potassium oxide in coal ash                                             | K₂O    | %                        | 0.09                       | GB/T1574-2007     |
| Titanium dioxide in coal ash                                            | TiO₂   | %                        | 0.58                       | GB/T1574-2007     |
| Sulfur trioxide in coal ash                                             | SO₃    | %                        | 1.60                       | GB/T1574-2007     |
| Manganese dioxide in coal ash                                           | MnO₂   | %                        | 0.045                      | GB/T1574-2007     |
| Phosphorus pentoxide in coal ash                                        | P₂O₅   | %                        | 0.033                      | GB/T1574-2007     |
| Mercury in coal                                                         | Hg ar  | G/g                      | 0.020                      | ASTM D6722-2011   |
| Free silica in coal                                                     | SiO₂ (F) | %                        | 2.19                       | DL/T 258-2012     |
| Free calcium oxide in coal ash                                          | CaO (F) | %                        | 0.24                       | DL/T 498-1992     |
| Erosion wear index of coal                                              | Ke     | /                        | 2.3                        | DL/T 465-2007     |
Hetaoyu mine contains 2, 5, 8, and other 3 coal-mining seams, of which: 2, 5, coal seams for weak sticky coal, distribution is unstable, 8, coal seams non-stick coal, distribution is more stable, is the main coal mining layer in the region. The study of the characteristics of coal resources in the region, which is found to be low ash, medium to high volatilization, low sulfur, medium phosphorus, high heat, non-sticky, weak bonding, harder to grind, in the second stage of deterioration of soot, can be used as thermal coal and chemical coal[6].

4. An overview of coal resources in Tianshuibao coal mine

The Tianshuibao coal mine is located in the northern part of ring county in Gansu Province, where coal resources have been found 3.66 billion tons planned for the first and second coal mines. Mine No. 1 in the north, a small coal mine that has been mined for many years, has been depleted and closed, and the second mine in the south is under construction with a design capacity of 2.4 million t/a. Proven coal resources 3.14 billion t, plus 0.52 billion t.

The samples of the Tianshuibao coal mine were tested for full moisture, moisture, ash, volatile, full sulfur, heat, carbon and hydrogen, nitrogen, bonding index, coal fire temperature, zircon mudization experiment, carbon carbonate carbon dioxide. The detection data can be found in Table 3.

### Table 3. Coal Characteristics of Tianshuibao coal mine

| Raw coal measurement results | Mt full water% | Mad moisture% | Ad ash% | Vdaf (volatile)% | St, D (total sulfur)% | Qgr, V, D (high calorific value) MJ / kg | Qnet, V, AR MJ / kg | Coke slag characteristics (1-8) | Coking index | Ignition temperature of coal (°C) | Ignition temperature of raw coal sample | Ignition temperature of oxidized coal sample | Carbonate carbon dioxide% |
|-----------------------------|----------------|---------------|---------|------------------|----------------------|----------------------------------------|-------------------|-------------------------------|-------------|-------------------------------|-------------------------------|----------------------------------------|---------------------------|
|                             | 5.4            | 3.50          | 8.41    | 38.54            | 1.14                 | 29.30                                  | 26.72             | 2                            | 0                        | 289                          | 285                          | 2.56                                    |
|                             |                |               |         |                  |                      |                                        |                   |                               |             |                               |                               |                                        |                           |

Comprehensive analysis, the area can be mined 1-1 layer of medium ash, medium sulfur, high volatile fractions, medium heat value low coalification (CY42) long flame coal; Long flame coal[7]; coal 4-1 layer is medium ash, low sulfur, high volatile, high thermal value low coalification (CY42) long flame coal; coal 5-1 layer is medium ash, low sulfur, high volatile, high heat low coalization (CY42), coal 7-1 is medium ash, low sulfur, high volatile, medium heat low coalification (CY42) long flame coal.

5. The general idea of coal resource development in Qingyang City

Through the analysis of the problems encountered by developed coal resources cities, sum up lessons learned, recognize the importance and urgency of circular economy, fundamentally understand the concept, connotation and function of coal circular economy. Starting from the actual situation in Qingyang City, this paper analyzes the driving effect of coal resources on the economic and social development of Qingyang City, adheres to the sustainable development of the green coal economy as
the guide, fundamentally changes the current coal development process caused by the waste of resources, environmental pollution and the deterioration of the ecological environment.

5.1. Establish a green development concept
We earnestly implement the Party policies, always adhere to the economic construction as the center, grasp the pillar industries of the rich people, grasp the resources to develop the rich people. The rural economy of Qingyang City plays an important role in the urban economic pattern, protects the limited cultivated land resources, and the scientific use of land resources is of great significance to Qingyang City. Set up the concept of "green management" and improve the consciousness, initiative and enthusiasm of coal enterprises to implement circular economy. We should not only strengthen the special training of leading cadres, but also integrate them into the corporate culture of coal enterprises, form a strong propaganda campaign for the development of coal circular economy, hold regular seminars combined with enterprise development, carry out circular economy practice, and take the implementation of circular economy as the development strategy of coal enterprises, and comprehensively plan and implement them.

5.2. Improve the industry policy and regulatory system and supervision mechanism
For coal mines in the early stages of development, we must comprehensively demonstrate from the technical and economic aspects, strengthen overall planning, rational allocation of resources, and in the mining link, through optimizing mining design, the use of advanced technology and equipment, actively promote new technologies, new processes, improve the level of coal mining equipment and mechanization, improve the recovery effect and recovery rate, minimize the waste of resources, further improve the coal mining industry, make rational use of limited resources.

5.3. Develop a comprehensive utilization plan for coal resources
We should strengthen the comprehensive utilization of coal, gas, mine water and other resources, and improve the utilization rate of coal resources. By improving the productivity of coal enterprises, promoting the growth of enterprises, so that coal enterprises output per unit of resources, reduce energy consumption, or increase the output of per unit of resources. Intensive resource management with energy saving and consumption reduction, while reducing energy consumption and improving the efficiency of resource utilization.

5.4. Strengthen government-led and establish incentive mechanism
The government should attach great importance to the implementation of coal resources development and utilization strategically. On the basis of implementing relevant laws and regulations and plans, establish a fiscal, financial, industrial and policy guarantee mechanism conducive to the development of coal resources, and encourage and support coal development to achieve harmonious unity of economic development and social development [10]. Encourage coal enterprises and related industries to penetrate each other in the coal industry chain, strengthen alliances, complement each other advantages and develop together, promote the development of the coal industry chain, and provide sufficient systematic space for the development of the circular economy of coal enterprises. Coal enterprises should give financial and policy support to environmental protection and comprehensive utilization of the resource industry.

6. Conclusion
This paper analyzes the coal quality, coal rock characteristics and coal resource characteristics of the two coal mines in walnut and sweet water castle. By analyzing the problems encountered by developed coal resource cities, the relevant suggestions are given, and the corresponding departments should deepen the research on the rational use of coal resources technology and introduce corresponding policies and systems to achieve the goal of ecological greening and sustainable development.
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