Study on coal quality development and application in Hetaoyu coal mine

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Abstract. Based on the research at home and abroad, the development and application of coal quality in Hetaoyu coal Mine was studied in this paper. We focus on the coal quality development, application process in accordance with local conditions, improving coal quality utilization rate, and environmental protection. The quality data of Walnut Valley coal are analysed. Some Suggestions on the development and application of coal quality are put forward.

Keywords: Coal mine quality; Cause analysis; Sustainable; The Problems and responses.

1. Introduction

China is the world's largest consumer of mineral resources. The people's production and life are inseparable from coal resources, which have become the main pillar of the economy in many places. China's output of mineral resources accounts for one half of the world's, but the utilization efficiency of coal resources is low, the comprehensive utilization rate is low, a large number of coal resources are wasted. Therefore, it is necessary to improve the utilization efficiency of resources, reduce the waste of mineral resources, and ensure the sustainable and healthy development of China's coal resources industry.

Since 2014, China's macro economy has shown a trend of slowing down and optimizing its structure. By the end of 2015, China's coal mining capacity totaled 5.7 billion tons, including 3.9 billion tons of normal production and renovation capacity and 1.496 billion tons of new and expanded capacity, according to the China coal association. China's coal consumption is expected to total 4.3 billion tons in 2015. This means that the country has an excess coal capacity of 1.4 billion tons, and future capacity remains a serious challenge.

Qingyang city in Gansu province has the most abundant oil, coal, natural gas and other resources. However, due to the poor transportation conditions, backward resources exploration and development and other factors, Gansu has been an economically underdeveloped region with weak industrial base, single industrial structure and small economic aggregate. To speed up the development of coal industry, actively push forward coal electrochemical integration development, the implementation of the strategy of implementing the western development, can become as one of the great power of other local industry development, promote the local rich, adjust the industrial structure, the transformation of the mode of economic growth, high economic and promote the industrialization process, increase local fiscal revenue,
2. Research status of the development and application of coal mine media at home and abroad

2.1. Research status abroad
Canada is mainly a green mining system, strict procedures, every link has to go through a strict assessment and approval, pay special attention to the tailings treatment and disposal process before the strict application and approval. According to the relevant provisions, it should be careful to the harmful material in tailings processing, mining recovery, recycling and reclamation should be handled carefully, the applicant to submit the report should include all of the ground construction and operating equipment and tailings and waste disposal, and should include mining recovery, recycle and regeneration of specific methods and measures for the plan, tailings device is equivalent to the processing of mining equipment.

Australian research focuses on "mining and recycling". The contents include: (1) the mining environment restoration performance bond system; (2) treatment of acidic waste water; (3) other pollution control; (4) land reclamation; (5) vegetation restoration; (6) acceptance of mine environmental treatment. Acceptance criteria: first, the environment is restored after the terrain is scientifically sorted out; The second is the number and diversity of biological organisms’ sex; Third the shape of waste rock and landscape close to nature.

South Africa is a typical mining country, and its mining construction system has experienced a typical post-treatment pollution, from imperfect system, laws and regulations to a more perfect stage. The mineral resources act of 1992 required all mining and mineral processing plants to submit plans for reclamation and implementation and established a deposit system for restoring the mining environment to protect the mining environment.

2.2. Several domestic coal quality development and application cases
New ridge Hegang coal mine green mine construction strategy research, coal face of deep contradictions and enduring difficulties, from the transition of other province coal mine enormous pressure of competition, in which the constraints of local interests will become obstacles to the sustainable development of the new mine resources and transform in difficulties, and work with the green mine construction comprehensively, the difficulty of the work are going up, the demand of increasing the capital, human resources development level is low, and many a hole in the subsidence area are to be adjusted[1].

The problems and countermeasures existing in the exploitation and utilization of coal resources in Shanxi, and the difficulties in the exploitation and utilization of coal resources in Shanxi are analyzed. For this kind of situation, enhancing the promotion of reasonable exploitation of coal resources is put forward, to improve the entire province people saving consciousness, strengthening policy system, through the resource integration to ensure reasonable exploitation of coal resources, perfect the relevant laws and regulations, reform of coal resources specification of coal resources, market development, strengthen the coal resources investigation plan and countermeasures such as the United States geological survey work [2].

Taking 21 coal mines in Yangquan city, Shanxi Province as examples, the main factors influencing the economical and intensive utilization of coal resources are: (1) conditions of coal resources, (2) technical conditions of coal resources development, (3) investment in coal resources development, and (4) order of coal resources development [3].
3. Analysis of Hetaoyu coal mine

3.1. General situation of Hetaoyu coal mine
The Hetaoyu mine well field is located in the southwest of Zhengning county. The east-west length of the well field is about 15.429km, the north-south width is about 12.399km, the area is 191.30km², and the coal resource is 2116.09Mt. The well field contains three layers of minable coal seam, which are numbered as 2 coal, 5 coal and 8 coal from top to bottom. The coal quality of coal 8 in minable coal seam is low ash, low sulfur, extremely low phosphorus and high caloric value non-viscous coal, which can be used for power coal, civil coal and chemical coal. Main inclined shaft, auxiliary shaft and return shaft are used in the mine. The length of the main inclined shaft is 5875m, and the depth of the auxiliary shaft and the return shaft is 975m. The mine is designed to have a recoverable reserve of 1176.4Mt, a designed production capacity of 8.0Mt/a, and an annual coal output of 20 million tons, which is the largest scale and largest investment plan in the history of coal development in Gansu province.

3.2. Physical properties of coal
The appearance and physical properties of the 6 workable coal seams in the zhuluotong Yenan formation of coal bearing strata in this area are basically the same, all of which are bituminous luster ~ weak bituminous luster, black ~ gray black and brown black strip. Most of the fractures are blocky, semi-rigid, shell-like and crisscrossed. Coal contains pyrite thin films with pyrite nodules and bedding distribution. The most significant physical characteristics of each joint are dull gloss and toughness, flammability, smoke concentration, flame length, melt not expanding nor slag burning. The average true density of coal is between 1.52 and 1.71g/cm³, and the average apparent density is between 1.36 and 1.38g/cm³.

3.3. Environmental impact of coal mine development and application
The exploitation and utilization of mineral resources not only provides important raw materials and energy for economic development, but also plays a great role in promoting economic development and has a great impact on the environment. Some unreasonable mining methods have seriously damaged the ecological environment, such as air pollution, water pollution, soil pollution, soil erosion and other problems, which will directly affect the economic, social and ecological sustainable development of the environment. According to statistics, China's mining development has damaged more than 4 million hm² of land, and is increasing at the rate of 20,000 hm² per year. However, the land reclamation rate is less than 12%, seriously damaging land resources and ecological environment [4].

3.4. Development strategy selection of Hetaoyu coal mine
Table 1 shows opportunities and challenges coexist with the rapid growth of the market. The advantages and disadvantages of this region are mainly water shortage and the products in the export channel of lean coal are larger, which directly affect the development progress of coal resources. As a new coal energy industrial area, facing the future development of coal industry and coal conversion technology, the development strategy of this area mainly includes strategy (growth strategy) and strategy (reverse strategy).
### Table 1. Development strategy selection of Hetaoyu coal mining area

| Internal ability | Favorable potential (S) | External factors | Negative potential (W) |
|------------------|-------------------------|------------------|------------------------|
|                  | 1. Geographical advantages of old areas | 1. It belongs to arid areas and lacks water resources. |
|                  | 2. Resource advantages | 2. Backward infrastructure and engineering construction poor thing. |
|                  | 3. Technical management advantages | 3. Poor transportation conditions, coal chemical products transport Lose difficult. |
|                  | 4. The war in line with the country's western development outline requirements and national industrial policy. | 4. Poor natural environment, attractive talent Limit. |
| Computer association (O) | SO strategy - growth strategy | WO strategy - twisting strategy |
| 1. On strengthening the fight against poverty hold the guidance of the development and construction of old revolutionary base areas opinion. | 1. Attract investment with the advantage of coal resources careful attention. And investors have done well. | 1. Use state support policy to solve water shortage problem. |
| 2. The adjustment of national energy distribution led to me China's energy industry is moving west. | 2. Make use of the management advantages of central enterprises and state-owned enterprises, capital advantage, high starting point, strict requirements, we will support key industries to grow stronger and larger. | 2. Crack the construction of transportation lines for coal and coal chemical products. |
| 3. Clean coal in energy development planning policy. | Implementation Green mining, clean use, accelerate capital source advantage into economic advantage. | |
| Challenge (T) | ST strategy - diversification strategy | WT strategy - defensive strategy |
| 1. Strong development of coal chemical industry in all provinces. | 1. According to the characteristics of local resources, the implementation is wrong bit development, complementary development. | 1. Centralized processing of emissions to enhance value, turn waste into treasure. |
| 2. The development of the energy sector, two-way penetration The integration of the industry competition situation further more complicated. | 2. Relying on green coal mining technology clean use, efficient transformation into a way, increase the added value and diversity of products sex. | 2. Highly segmented market, according to coal production the quality of products, only focus on some markets |
| 3. Tightening environmental policies, energy conservation and emission reduction pressure builds up. | | To improve the competitiveness of the market, gradually shrink business in other markets. |
| 4. Resource endowment of Shanxi, Mongolia, Gansu, Shaanxi and Ningxia near, industrial structure convergence, project layout competition is fierce. | | |

#### 4. Suggestions on the development and application of coal quality in Hetaoyu coal mine

At present, the main ways to convert coal into clean energy products are power generation, kerosene, methanol and so on. The energy efficiency of different utilization methods from low to high is indirect coal-to-oil (42% ~ 47%) < power generation (38% ~ 45%) (only about 40% after deducting self-use electricity) < methanol (47% ~ 50%) < coal-to-natural gas (56% ~ 60%) < low-order coal extraction
(75%). High efficiency conversion energy conversion efficiency of coal cleaning in 60% ~ 70%, low water consumption, low cost and product diversity [5-8].

4.1. Selection of coal power generation technology
The coal gangue power plant USES the coal mining and the solid waste treatment to clean the discharge as the fuel of the power plant. Develop coal gangue Power plant is an inevitable choice for China to implement sustainable development strategy, strengthen environmental protection, realize effective allocation and utilization of resources, and adjust coal industry, industry and product structure.

At present, thermal power generation technologies mainly include supercritical power generation, gas-steam combined cycle power generation, IGCC, clean coal combustion power generation, coal-fired magnetorheological power generation, circulating fluidized bed power generation, air-cooled power generation technology, and circulating fluidized bed thermal power generation, electricity, gas-gas tar power generation technology developed by Zhejiang university.

Air-cooled power generation technology has opened up a water-saving, economic, safe and reliable way for the construction of large thermal power plants in coal mines and power load centers with severe water shortage, and has also created favorable conditions for the maintenance of natural balance in water-rich areas and the avoidance of river water pollution. Therefore, the air-cooling technology of power plants has been widely used in the world. In particular, the project is located in the arid area of western China, and the air-cooling technology has become a necessity. In other areas, there are relatively abundant water resources, so the utilization of air-cooling power station technology has also been paid great attention.

Circulating fluidized bed boiler. Circulating fluidized bed boiler has the characteristics of wide adaptability and simple system, suitable for high sulfur coal and low-quality coal. During the 12th five-year plan period, 600 and 1000MW supercritical circulating fluidized bed boilers were promoted for power generation. It not only consumes the inferior coal selected by coal preparation plant, but also provides the heat source for mine and coal preparation plant.

4.2. Selection of technical routes for coal chemical industry
Considering the condition of water (0.4 ton/tuns of coal carbonization water consumption), the mining area of transport conditions and investment economic conditions (annual output 400000 tons), the advantage of the characteristics of advantages to avoid disadvantages, give full play to the walnut low calorific value of coal, the low temperature inversion process is recommended for the combined with indirect coal preparation of fine chemical products. Low-temperature retorting refers to the operation of coke ovens producing semi-coke, coke oven gas, coal tar and other by-products from low-order bituminous coal at 500 ~ 580°C. The products include the following three.

Carbocoal. The most important low-temperature carbonization product (1 ton, 1.6 tons of coal coke), the gas can be used as a feedstock to prepare a water-containing preparation for syngas feedstock, and then a fee-toluene process route to produce high quality gas oil. The fischer-tropsch synthesis is to make synthesis gas from coal gasification of coal, and then under the action of catalyst, reaction indirect liquefaction process, liquid fuel from coal can not only refined gasoline, diesel, kerosene, such as ordinary oil products, can also be refined high-quality petroleum products such as jet fuel, lubricating oil and olefins, paraffin wax high value-added products (1 ton oil coking 4.5 tones).

Coal tar. Coal tar pretreatment, tar distillation, distillation washing, naphthalene distillation, refined phenol, pyridine refining, refined naphthalene, ancient Malone resin, refined anthracene, anthraquinone, modified asphalt, oil preparation coke oven gas.

Coke oven gas. It is mainly composed of hydrogen and methane, accounting for 56% and 27% respectively, with a small amount of carbon monoxide, carbon dioxide, nitrogen, oxygen and other hydrocarbons; Coke oven gas is an important gas fuel.
4.3. Gas pipeline transportation technology

The coal transportation in pipeline is based on water. The cleaned raw coal is crushed into fine particles and mixed with water to form a certain concentration of water coal slurry. The coal water slurry is pressed into the pipeline through artesian pump or high-pressure pump, and used after reaching the terminal point of dehydration. The process of coal transportation in the pipeline is shown in figure 1.

![Diagram](image)

**Figure 1.** The process of gas pipeline transportation

The pipeline coal transport system consists of three parts. The first station is the pulping plant, the intermediate station is the pipeline and pump station, and the terminal is the dewatering equipment. The role of the engineering pulping plant is to make the coal mill into coal and water mixed into coal slurry is the leading coal transportation.

Coal transported by pipeline has the following four advantages: first, highly adaptable terrain; second, small footprint; third, less than 40% of the metal pipe consumed by steel railways; fourth, low return on investment in coal transported by pipeline.

Coal pipelines have less impact on the atmosphere. Pipeline transportation is a safe, stable and efficient means of transportation. In the process of railway and highway transportation, motor vehicle exhaust and secondary dust will be generated, thus increasing air pollution, while pipeline transportation is closed transportation, these problems can be avoided, reduce air pollution, protect the atmospheric environment. According to relevant statistics, the coal loss rate of railway and road transportation is about 0.8% to 1%, while the coal loss rate of pipeline transportation is less than 0.1%. By contrast, the use of pipeline coal transport is the most effective way to reduce the loss of transport, not only has good economic benefits, and reduce the environmental pollution, environmental benefits are very obvious.

It is a new idea to use the route of coal transport in pipeline. The coal from wanyu mining area is made into coal slurry and transported to the high-tech zone to realize classification of coal data, quality separation, environmental protection, clean and efficient utilization. It is also a safe, efficient, clean, environmentally friendly, energy efficient and overland transportation. The coordinated development of longdong and longzhong areas and the comprehensive utilization of upstream and downstream products have been realized with remarkable economic benefits. In addition, coal water slurry technology as gasification raw material and coal-based clean fuel, after more than 30 years of research and practice, has entered the promotion stage, with a very wide range of application value [9-10].

4.4. Suggestions on coal mine development and application

Strictly abide by industrial policies. Industrial policy is a measure that the government intervenes in the formation and development of industries to achieve certain economic and social goals. In recent years, the State Council and the competent department in charge of dense energy-intensive industries planning was introduced, including upper and lower linkage, "10 aspects" overall planning, emphasis on industrial convergence and industry convergence, limit bearing industry development, the energy control transfer area and water shortage area of energy resources bearing industry, adopted a policy of total amount control, strict access industry, its fundamental purpose is to prevent blind expansion of energy-intensive industries, adjust and optimize industrial structure effectively. As the executor of the policy, only by strictly following the scale, energy consumption and other indicators limited by the policy, and not exceeding the red line, can the project be guaranteed to proceed smoothly, obtain strict economic benefits, and achieve the purpose of investment. To ensure adequate resources. Coal chemical project water and coal consumption is large, to do a good job of research and demonstration and water supply recommended agreement. Coal mine should do a good job in coal transport and resources research, verify the coal quality data, provide reliable basic data for business decision-making. Implementation of site selection and land use projects. In order to meet the needs of coal mine development, it is suggested to select a site carefully and do the examination and approval of land use with relevant
departments. Sufficient capital guarantee. Coal conversion projects occupy a large amount of capital, good capital reserves for the success of the project plays a decisive role. It is suggested to raise funds through various channels such as society, the legal person, individual, sino-foreign joint venture, cooperation and equity transfer to ensure the smooth construction and operation of the project.

5. Conclusion
Walnut valley coal mine development application must judge scientifically local the coal handing, resources and the market demand, choose efficient paths, SWOT analysis, choose the clean utilization of coal mining and green way, solve the problem of water shortages, create favorable conditions for development of coal resources, gradual development, pay close attention to the development trend of coal chemical industry. At the same time, with the development of coal resources, it will drive the development of a series of industries such as transportation, water, electricity, coal chemical industry and so on.

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