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Study on Influencing Factors of Coal Quality in Coal Blending

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Abstract: In this paper, the indexes of various single coal are determined, and the influencing factors of coal blending are studied by changing different proportions. The experimental results showed that water content had no change rule and had little effect on coal blending index. The ash content in coal increases, the calorific value decreases. The volatilization has additivity which is directly proportional to the calorific value of coal. Sulfur content has great influence on processing equipment and environment. Sulfur content has additivity.

1. Introduction

1.1. Present situation of coal blending development

Coal blending is the mixing of two or more different types of coal to form a new type of coal that meets the requirements of the boiler. The type and structure of the boiler are different. There are different requirements for the quality of the coal. At present, China's coal blending technology is to study a variety of single coal optimization, give full play to the advantages of each single coal, and make the blended coal not only meet the requirements of furnace type (boiler efficiency is the best), but also make the product cost the lowest (coal blending and use units have good economic benefits). Therefore, coal blending technology is actually the process of the design and control of various single coal optimum formulation and the ultimate realization [1-3].

Developing coal blending coking technology has always been the main measure to rationally utilize coking coal resources and improve coke quality in China. However, there is no new breakthrough in research and development of coal blending technology, especially in production, which is one of the main crux of low coke quality in China. The maximum effect of power coal blending is to provide stable quality coal, while giving full play to the characteristics of single coal, providing products that can meet the requirements of different coal-fired equipment, so as to improve efficiency, save coal and reduce pollutant emissions from the total amount. Since the advent of power coal blending technology in 1979, it has been first applied in coal distribution departments and a small number of users in several big cities, and achieved some results. However, coal blending in China is still in the initial stage, the proportion of coal blending is still very small, and coal blending technology is relatively simple, far from meeting the needs of the development of China's socialist market economy. It is necessary to further improve and develop coal blending technology [4-5].

1.2. Main research indexes of coal blending

(1) Water content

The water content of coal is determined by the industrial analysis of coal. Water is the water of air drying coal samples (M_{ad}). A certain number of coal samples is pre-air-dried into air-dried coal samples for laboratory use, which are dried to a constant weight at 102-105℃, make the coal sample completely dry. Then, according to the lost quality of the coal sample, the water content of the coal is calculated.

(2) Ash content

The remaining residue after burning coal is called ash. Ash all comes from minerals in coal, but its composition and weight are different from minerals in coal. Therefore, the ash content of coal should be called ash yield.

(3) Volatiles

The volatile decomposition product of organic matter in coal is called volatile matter. In addition to nitrogen, hydrogen, methane, carbon monoxide, carbon dioxide and hydrogen sulfide, there are also some complex organic compounds. In the experiment, the coal sample is heated at high temperature under the condition of insulating air. The total amount of liquid and gas decomposed by organic matter in coal is minus the water content, which is the content of volatile matter.

(4) Total sulfur

The proportion of sulfur in coal is the sulfur content of coal. The sulfur in coal can be divided into organic sulfur and inorganic sulfur according to the existing state. Sometimes there are trace elemental sulfur in monomer state. The coal with a total sulfur content of more than 3% is called high sulfur coal. But the environmental protection administration believes that more than 2% is high sulfur coal [6-8].

(5) Calorific value

The heat generated by coal combustion in oxygen bomb is called coal calorific value. According to the input of sulfur, hydrogen, total water and analytic water; the high calorific value, low calorific value and cartridge calorific value of coal can be calculated automatically [9-10].

The difference between high calorific value and low calorific value lies in whether the water in fuel combustion products is liquid or gaseous. Water is liquid, which is called high calorific value. Water is gaseous, which is called low calorific value. The low calorific value is equal to minus the condensation heat of water vapor from the high calorific value. Fuel is mostly used for combustion. The exhaust gas temperature of all kinds of boilers exceeds the condensation temperature of water vapor. It is impossible to release the condensation heat of water vapor. Therefore, the low calorific value of fuel is generally used as the calculation basis in energy utilization. Different countries have different choices. Japan and North America are accustomed to using high calorific value, while China and Germany are accustomed to using low calorific value. Some countries adopt both calorific values [11].

2. Experimental part

2.1. Raw materials and instruments

Experimental materials：A（Coal samples from Huanxian, Gansu），B（Coal samples from Yinchuan, Ningxia），C（Coal samples from Huating, Gansu）

Main experimental instruments：Rapid sulfur analyzer, Han Xian fully automatic calorimeter, Automatic industrial analyzer, muffle furnace, bake out furnace。

2.2. Experimental steps

2.2.1. Preparation of coal sample

(1) crushing coal samples with a hammer

(2) sifting: Coal sample is sieving after each crushing. The coal sample that has not been passed is smashed again. The coal sample is screened to a particle size below 1.5mm.

(3) blend: Mix coal samples of different sizes.

(4) Put it in a beaker and put the corresponding label on it.

2.2.2. Determination of coal blending index

(1) Determination of water, ash and volatile matter in coal samples by automatic industrial analyzer.

(2) Determination of total sulfur in coal samples by rapid sulfur analyzer.
(3) Determination of calorific value in coal samples by Han Xian fully automatic calorimeter

3. Results and discussion

Table 1 Coal quality analysis of single coal

index / coal	M_{ad}	A_{ad}	V_{ad}	$S_{t,ad}$	$Q_{b,ad}$	$Q_{gr,v,ad}$	$Q_{net,v,ar}$
A1	15.23	14.57	23.38	1.32	5829	5818	5102
A2	14.98	14.04	22.76	1.57	5936	5887	5246
A average value	15.10	14.31	23.07	1.445	5882.5	5852.5	5174
B1	12.22	14.5	27.37	0.44	5751	5740	5031
B2	12.37	15.31	28.68	0.42	5778	5719	5172
B average value	12.29	14.90	28.02	0.43	5764.5	5729.5	5101.5
C1	10.78	10.23	24.68	0.53	4697	4687	4059
C2	10.02	11.33	25.19	0.62	4729	4701	4015
C average value	10.4	10.78	24.93	0.575	4713	4694	4037

It can be concluded from the above table that the highest water content of the three coal samples is A coal and the lowest is C coal. The coal with the highest ash content is B coal and the lowest is C coal. The coal sample with the highest volatile content is B coal and the lowest is A coal. The highest sulfur content is A coal and the lowest is B coal. The highest calorific value of coal sample is A coal, the lowest is C coal. Different types of coal have great differences in properties. The proportion of water and ash in inorganic components is relatively low in coal, and ash is a harmful substance. The ash content in the power coal increases, the calorific value decreases, the slag discharge increases, and the coal is easy to slagging. However, volatile and fixed carbon have a large proportion of organic components in coal. Sulphur content has great influence on industrial production equipment.

Table 2 Analysis results of various coal blending quality

index / coal	Mixture ratio (A:B:C)	M_{ad}	A_{ad}	V_{ad}	$S_{t,ad}$	$Q_{b,ad}$	$Q_{gr,v,ad}$	$Q_{net,v,ar}$
Coal blending 1	6：2：2	14.8	14.5	23.5	0.65	5625	5614	4914
Coal blending 2	5：3：2	13.9	15.3	23.8	0.76	5501	5490	4800
Coal blending 3	4：3：3	12.5	16.8	25.8	0.9	5435	5424	4739
Coal blending 4	6：3：1	14.7	13.6	27.4	0.83	5621	5610	4911
Coal blending 5	4：4：2	15.1	13.7	24.4	0.61	5182	5171	4500

Coal blending 6	4：5：1	14.2	15.2	25.6	1.17	5398	5387	4705

The biggest effect of coal blending is to provide stable quality coal and give full play to the characteristics of single coal. Coal blending can provide products that meet the requirements of different coal-fired equipment, so as to improve efficiency, save coal and reduce pollutant emissions from the total amount. This paper mainly studies the six kinds of coal blending indicators, and studies the advantages and disadvantages of various coal blending, so as to get a more ideal coal blending scheme, and then study the coal quality influencing factors. From Table 2 above, it can be concluded that the change of water content is irregular, and the influence on coal blending is not clear. Ash, volatile, total sulfur content and calorific value all have certain regularity, ash and volatile content are related to calorific value. Coal blending suitable for various requirements can be selected according to this property.

4. Conclusion

In this paper, the indexes of each single coal are determined first, then the influencing factors of coal blending quality are studied through the relationship between different proportions. The experimental results show that the base water of air drying is within the range of repeatability error, but different storage conditions will have a greater impact on the base water of air drying. The change of water is irregular and has little effect on the index of coal blending. When the ash content in coal increases, the calorific value decreases. Volatile matter is the thermal decomposition product of organic matter in coal. Volatile matter is additive and proportional to the calorific value of coal. Sulfur content has great influence on processing equipment and environment. Sulfur content has additivity.

Water is vulnerable to environmental impact and has no regularity. In the process of coal blending, the error of water effect is particularly obvious in predicting coal blending properties. Because ash, volatile matter, total sulfur and calorific value show good additivity under the basis of drying base, this method can be used to predict coal blending properties.

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Reference

[1] Wang, F. L. (2008) Analysis of main coal quality indexes in power coal blending. Journal of the Hebei Academy of Sciences, 25:45-47.
[2] Zhang, C. W. (2008) Development of mixed burning system optimizing with multi coal blending. Hua Zhong University of Science and Technology.
[3] Wang, Y. J., Zhao, H. X., He, J.D. (2004) Study on additivity of main coal quality indexes of power coal blending. Application of energy technology, 10:17-19.
[4] Wang, K. M., Cai, B. (2010) The role of coal quality analysis in coal blending detection. Coal processing and comprehensive utilization, (3):28-29.
[5] Hu, C. (2013) Influence of coal blending combustion on safe operation of boiler. Clean coal technology, 19:73-76.
[6] Zhang, Z. P., Peng, J. L., Zou, Z. Y. (2013) Determination of total sulfur in coal. Clean coal technology, 19:43-46.
[7] Liu, Z. C., Lu, Z.H., Chen, H. Z., etc. (2004) The structural relationship between the coal quality index of power coal blending and the ratio of single coal. Coal science and technology, 33:62-64.

[8] Liu, J. B. (2013) Discussion on index relation and index of industrial analysis of coal. Energy and energy conservation, (6):28-29.
[9] Yang, Y. K. (2014) Industrial analysis process and significance of coal. Value engineering, (1):46-47.
[10] Chen, H.B., Bai, X.F., Luo, Y. F. (2010) Study on the relationship between the calorific value and moisture content, ash content of coal. Coal Quality Technology, (4):26-28.
[11] Lu, J., Li, M., Zhang, H. (2004) Calorific value of coal industry analysis compared with oxygen bomb method determination results. Cement, (4):49-51.