Study on the industrial analysis and calorific value of coal blending

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Abstract. The industrial analysis of coal can reflect the characteristics of coal and correctly evaluate the coal quality. The water, ash, volatile and fixed carbon in coal is determined by industrial analyzer. We can preliminarily judge the properties, type of coal and the way of coal processing. Calorific value is an important index for power coal blending, so measuring and analyzing calorific value is very important for coal blending. In this paper, Jing Yuan coal, Hua Ting coal and Ning Xia coal are used to analyze the effects of various indexes on calorific value.

1. Introduction

Several kinds of raw coal are mixed in a certain proportion, then coal blending is made. Through industrial analysis, it is judged whether the utilization of coal blending is better than single coal. The industrial analysis of coal can determine the composition of the coal. Under the prescribed conditions, the composition of coal is approximately divided into four components: water, ash, volatile and fixed carbon. Industrial analysis is a conditional experiment. Ash, volatile and fixed carbon are the transformation products of coal under specific conditions, they are not the inherent component of coal. The determination results vary with the measurement conditions. In order to make the results comparable, industrial analysis methods have strict national standards. In the four indicators of industrial analysis, ash can approximately represent inorganic matter in coal, volatile and fixed carbon can approximate represent organic matter in coal. Although the industrial analysis is simple, the analysis results are very important to the study of coal properties. Domestic scholars have done a lot of research on the industrial analysis process of coal [1-3].

The calorific value is an important index to evaluate the quality of power coal and power coal blending. In the coal trade and industrial application, calorific index is divided into high calorific value and low calorific value. Ash and water have a significant influence on the calorific value [4].

2. The indicators of coal

2.1. The water of coal

Water is an important part of the industrial analysis of coal. It is divided into two kinds: free water and combined water. Free water mainly exists on the surface of coal. Free water can be divided into internal and external water. The sum of the two kinds of water are the total water of coal. In other words, when coal is exposed to air for a long time, it loses external water. The water that has not been completely lost is internal water [5-6].

2.2. The ash content of coal

The ash content of coal comes from the change of coal. It is not the coal itself, nor the specific component of coal. There is a big difference between ash and mineral. Compared with mineral, ash yield is low. Minerals and ash are also different in composition. The minerals in the coal are oxidized to form ash [7].

2.3. Volatile and fixed carbon

The water and ash content of coal fully reflect the composition of inorganic matter, while volatile and fixed carbon reflect the composition of organic matter in coal. Volatile can reflect most of the properties of coal. Volatile data is needed in many studies [8].

2.4. Calorific value

The calorific value of coal is the heat produced by the combustion of coal. In the process of combustion or gasification, we need use calorific value to calculate thermal equilibrium, coal consumption and thermal efficiency. It is mainly divided into high calorie and low calorie. The low calorific value is the high calorific value of coal minus the heat of vaporization of water [8].

3. Experimental part

3.1. Experimental materials
Jing Yuan coal, Hua Ting coal and Ning Xia coal.

3.2. Experimental instrument
Z-2000 Fully automatic industrial analyzer, Full automatic calorimeter.

3.3. Preparation of coal samples
The coal samples from three different areas were crushed and screened respectively. The proportion of coal blending was 1:1. Three kinds of single coal were mixed with each other. Then three kinds of coal blending were obtained [9]. A: Jing Yuan coal – Hua Ting coal; B: Hua Ting coal – Ning Xia coal; C: Jing Yuan coal – Ning Xia coal.

3.4. Determination of water, ash, volatile and fixed carbon
The results were determined by Fully automatic industrial analyzer, as shown in Table 1.

Table 1. Industrial analysis results of coal samples

	Jing Yuan coal	Hua Ting coal	Ning Xia coal	A	B	C
water Mad（%）	9.85	14.06	12.63	11.93	13.18	11.18
	9.97	14.04	12.61	11.97	13.08	11.02
water average	9.91	14.05	12.62	11.95	13.13	11.10
water theoretical value				11.98	13.33	11.26
ash Aad (%)	7.73	9.59	14.76	9.19	12.53	12.04
	8.39	9.58	14.81	8.93	12.55	12.10
ash average	8.06	9.585	14.78	9.08	12.54	12.07
ash theoretical value				8.82	12.18	11.42
volatile Vad (%)	30.03	24.32	22.44	28.33	23.76	27.43
	29.93	23.92	22.16	28.90	23.78	26.66
volatile average	29.98	24.12	22.3	28.63	23.77	27.03
volatile theoretical value				27.05	23.21	26.14
fixed carbon Fcad(%)	52.39	52.03	50.17	50.55	50.68	50.69
	51.71	52.46	50.42	50.20	50.44	49.35

fixed carbon average	52.05	52.24	50.29	50.37	50.56	49.80
fixed carbon theoretical value				52.14	51.27	51.17

From the above table, we can see that the three kinds of coal blending are compared with each other. It is concluded that the content of water, ash and fixed carbon in the group B is the highest, the coal sample with the highest volatile content is group A. There is a large difference in the types of coal blending distribution. The components of coal blending are higher than single coal. Water, ash, volatile and fixed carbon have additivity in coal blending.

3.5. Determination of calorific value
The calorific value of each coal sample was determined by Full automatic calorimeter. The results were shown in table 2.

Table 2. Determination of calorific value

	Jing Yuan coal	Hua Ting coal	Ning Xia coal	A	B	C
low calorific value (J/g)	5287	4983	4576	4987	4896	4939
	5309	4994	4591	5155	4710	4987
low calorific value average	5298	4998	4583	5051	4803	4963
high calorific value (J/g)	6018	5689	5247	5799	5468	5682
	6042	5701	5263	5727	5520	5652
high calorific value average	6030	5695	5255	5763	5494	5667
bomb cylinder calorific value (J/g)	6032	5700	5258	5789	5547	5681
	6056	5712	5273	5757	5463	5675
bomb cylinder calorific value average(J/g)	6044	5706	5265	5773	5505	5678

From the above table, it can be concluded that Jing Yuan coal has highest calorific value, the second is Hua Ting coal, Ning Xia coal has lowest calorific value. In group A, the calorific value of coal was hardly increased, while the calorific value of the coal in group B and group C increased. It is not necessary to improve the calorific value after the coal blending, there is a problem of the optimum ratio. It can be seen that the content of water has a great influence on calorific value.

4. Conclusion
The content of water, ash, volatile and fixed carbon were determined by the industrial analysis of coal. The coal blending was evaluated to see whether the coal blending was improved. The results show that the water content of coal blending has good additive property, the ash content is also good additive. However, due to the influence of water changes, the volatile and fixed carbon content of coal blending are not very additive.

The high water content of coal will directly affect the reduction of low calorific value. For the same area of coal，the high calorific value usually decreases with the rise of ash content. This is because the mineral content of coal is high。When the calorific value of coal is measured, the coal must be decomposed to absorb heat, so the high calorific value of coal will be reduced more. The volatile of inorganic mineral in coal has nothing to do with calorific value, while the volatile of organic mineral in coal is related to calorific value. For the same area of coal, the calorific value increases with the rise of fixed carbon content, because the fixed carbon of coal is mainly composed of element C, there are some combustible H and S elements, coal also contains a very small amount of non combustible elements such as O and N.

The calorific value of coal has a good linear relation with water and ash. Volatile and fixed carbon belong to organic matter, so it has a great influence on calorific value. Some calorific value of coal

blending has increased, some calorific value of coal blending has reduced. In order to increase the calorific value of coal blending, the optimum ratio is required.

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