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Study on the Hg content of coal in Dawan coal mine

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Abstract. The phase composition of raw coal in Liupanshui Dawan coal mine was analyzed by XRD, and the Hg content of raw coal was measured by atomic fluorescence spectrometer. The results showed that the Hg content in the coal increased with the ash increasing, which indicated that Hg had a certain inorganic affinity. When the density exceeded 1.8g/cm^3, the maximum Hg content reached to be1.59 ppm. At the same time the maximum sulfur and ash also measured respectively, it is 1.57% and 62.75%.

Introduction

Hg is a poisonous substance. Although the impact of Hg pollution on the ecological environment is relatively slow, but it can cause long-term harm once it enters the ecological environment, not only accumulates in the plant body, enters the food chain through the plant body, produces the toxicity to the plant, but also can accumulate in the human body, poses the serious threat to the human. A large part of Hg comes from human activity in atmospheric environment, the Hg released by coal-fired accounts for a large part of Hg released by human activities [1-3], according to statistics, the total amount of mercury released to the atmosphere in the world is about 5000 tons per year, of which 4000 tons are man-made results.

Hg is volatile, mainly distributed in pyrite of coal with solid solution, there may also be partially fine independent mercury minerals found in pyrite and in organic fractions. Coal combustion releases mercury into the atmosphere and then sinks to the ground, which is the main channel for mercury in the environment.

The Hg content of coal in China is very uneven, Hg content of coal is low in the northeast, Shanxi, and is high in Guizhou and Yunnan, the Hg of coal there is a trend which increases from north to south. China is not only a big country in mercury production, but also a big country in mercury use and mercury emission. Burning coal inevitably releases large amounts of waste gas into the atmosphere, and also releases a large amount of volatile and harmful elements such as Hg to the atmosphere[4-5]. This is the major factor contributing to the high atmospheric Hg emissions in our country. In the last 20 years, atmospheric Hg concentrations have been increasing globally, one of the most important factors is the increasing consumption of coal in the world.

For a long time, in the composition of China's energy consumption, coal has always occupied the dominant position, according to the energy strategic objective of national sustainable development, the proportion of coal consumption should be controlled at about 60% by 2030, the emission of SO_2, NO_X, smoke dust, PM2.5 and Hg emissions accounted for more than 60% of their respective total emissions in China. This paper study on the content of Hg in Dawan coal mine in Liupanshui area, it can provide theoretical basis and technical support for resource utilization of high Hg content coal .

Experiment

The coal samples used in the experiment were collected in Liupanshui Dawan coal mine. First, the coal samples were dried and sieved, divided into different particle size grades, and then according to the grain size> 50, 50 ~ 25, 25 ~ 13, 13 ~ 6, 6 ~ 3, 3 ~ 1, 1 ~ 0.5, <0.5mm divided into eight parts. The size of the coal for the crushing, grinding, respectively, over 80 mesh and 200 mesh sieve, then sealed

in a small glass bottle in the dark. The coal samples of each particle size are measured for moisture, ash and sulfur.

At the same time, select the coal samples according to <1.3, 1.3~1.4, 1.4~1.5, 1.5~1.6, 1.6 ~1.7, 1.7 ~ 1.8,> 1.8g / cm^3 divided into different density of seven parts. The flotation of the heavy liquid was a mixture of zinc chloride and water. Each of the density grade coal samples obtained after the ups and downs was crushed, ground, passed through 80 mesh and 200 mesh sieves, sealed in a small glass bottle in the dark to save, respectively, the density of the coal samples of water, ash, sulfur determination.

Accurately weighing the size of each grade, the density of coal samples 0.1 ± 0.0001g into the group has been numbered digestion bottle, add 50% of the water 10ml, in the 95 ℃ constant temperature water bath oscillation heating 1h. After adding 50% of the aqua regia 20ml, 1h after the solution from the water bath to remove the bottle to stand still cooling to room temperature, then add 1% potassium permanganate solution 40ml, put back to 95 ℃ constant temperature water bath heated to digestion The solution was completely clarified, and the solution was determined by filtration[6]. The Hg content was determined by AFS-9700 dual channel atomic fluorescence spectrometer.

Results and discussion

Raw coal XRD analysis. The raw coal XRD test pattern showed in Fig.1. According to the patterns, the scanning step was 0.05, scanning angle range was 5 ° ~ 65 °. The analysis of the material phase showed that the raw coal in Dawan coal mine contained quartz, kaolin, common pyrite, and so on minerals , contained a small amount of organic matter.

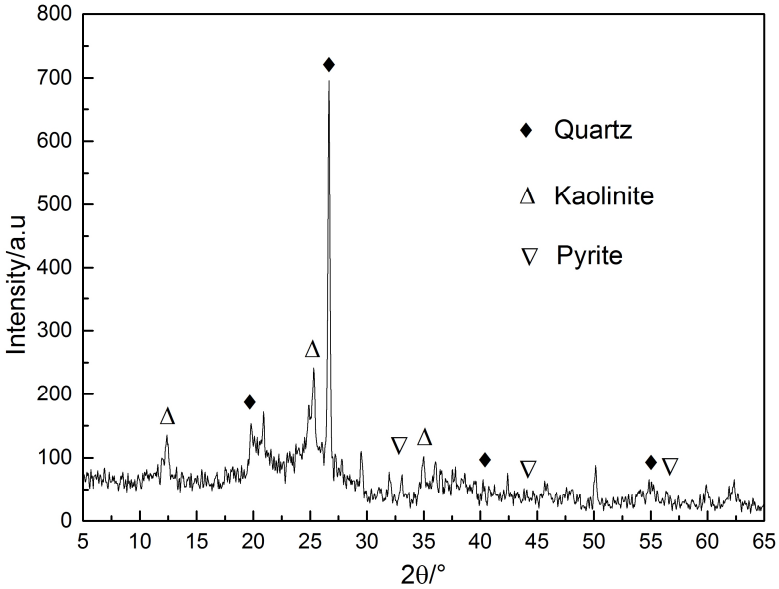

Fig.1 XRD patterns of raw coal in Dawan coal mine

Analysis of Hg content and ash and sulfur in different granular coal. Table.1 is the test results of different grades of raw coal ash, sulfur and Hg content, from the test data we can see the Sulfur and mercury increased with the increase of ash in coal. When the size of coal is above 50mm, the maximum Hg content is 1.56ppm, at the same time the ash and sulfur also reached the maximum, respectively is 67.28% and 1.12%. In different size grades of raw coal, Hg content and ash showed a strong correlation, which indicated that Hg had a certain inorganic affinity.

Analysis of Hg content, Ash and sulfur in different density level coal. The results of ash, sulfur and Hg content of the density of coal in Dawan coal mine are shown in Table.2. From the test datas can be seen, with the increase in the density of raw coal, ash and Hg content has also increased, when the density is over 1.8g/cm^3, the maximum Hg content was obtained 1.59 ppm. At the same time the sulfur and ash also measured the maximum, respectively,1.57% and 62.75%. ash and Hg content showed a strong correlation.

Table1. Ash, sulfur and Hg content in different size grades in Dawan coal mine

Size grade (mm)	ash A_d (%)	sulfur $S_{t,ad}$ (%)	Hg content (ppm)
+50	67.28	1.12	1.56
50～25	54.46	0.85	1.44
25～13	52.43	1.06	0.84
13～6	53.71	0.74	1.31
6～3	48.28	1.08	1.28
3～1	40.07	1.05	0.98
1～0.5	39.70	0.79	0.85
-0.5	37.79	0.71	0.79

Table 2. Test result of ash, sulfur and Hg content in each density level

Density ($g \cdot cm^{-3}$)	Ash A_d (%)	Sulfur $S_{t,ad}$ (%)	Hg content (ppm)
-1.3	13.57	0.89	0.68
1.3～1.4	15.72	0.91	0.75
1.4～1.5	22.31	1.21	0.87
1.5～1.6	29.80	1.34	1.01
1.6～1.7	42.35	1.39	1.21
1.7～1.8	50.07	1.46	1.47
+1.8	62.75	1.57	1.59

Fig.2 showed the relationship between the average density and Hg content of Dawan coal. It can be seen from the figure that there is a significant correlation between Hg content and average density, the fitting model value of R^2 was 0.9963, and between fitting model and actual data shown a good correlation.

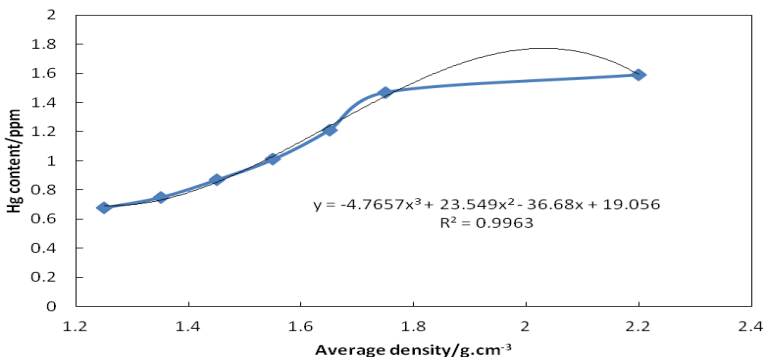

Fig.2 The relationship between the average density and Hg content of the coal

Comprehensive analysis the test results of Hg content, ash and sulfur of different size grade and different density in Dawan coal mine, when the size grade of raw coal is smaller, Because of the inclusion of impurities is less, so the ash is lower. Since Hg is generally enriched in the form of compounds in ash, sulfur and other impurities, so the Hg content increases with size grade of coal increasing. Hg content is low in the middle and low density level of raw coal, and is high in the high-density level.

Conclusions

There is a good correlation between Hg content and the sulfur, ash of the coal in Liupanshui Dawan coal mine, the Hg content increases with the ash increasing, which indicates that Hg has a certain inorganic affinity. The Hg content in the coal is proportional to the density and size of Dawan coal. When the size grade of raw coal is above 50mm, the maximum ash and sulfur respectively is 65.48% and 2.64%, and the maximum Hg content is 1.47ppm. When the density is greater than 1.8g/cm^3, the maximum mercury content is 1.59 ppm. At the same time the sulfur and ash also measured the maximum, respectively is 1.57% and 62.75%.

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