Measurement of Hg in the Coal of Liupanshui Mining Area

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Abstract. The phase composition of raw coal in Liupanshui Miluo area was analyzed by XRD, and the Hg content of raw coal was measured by atomic fluorescence spectrometer, and discussed the occurrence of Hg in the coal. The results showed that the Hg content in the coal increased with the sulfur, density, size and ash increasing. When the density exceeded 1.8g/cm^3, the maximum Hg content reached to be 1.68 ppm. At the same time the maximum sulfur and ash also measured respectively, it is 2.68% and 45.47%. The ash and sulfur in coal had high correlations with the content of Hg in coal, which indicated that Hg had certain inorganic affinity. The density distribution model of mercury in Miluo coal was obtained.

Introduction

For a long time, China's energy development is dependent on coal highly. According to statistics, since the beginning of this century, China's coal consumption accounted for the proportion of total energy consumption as high as 69% [1-3]. Coal as a fuel in the combustion process will emit a large number of pollutants, these pollutants in addition to CO_2, NO_X, SO_X and some soot, there are heavy metal elements which are harmful to the atmospheric environment, these heavy metal elements with the dust discharged the atmosphere , Causing air pollution. Hg is one of the heavy metal elements that cause harm in the combustion of coal. Hg in the combustion process, up to 150 ℃ begin to evaporate, most of the Hg discharge the atmosphere with the smoke. Hg is also enriched in coal ash, coal fly ash with particle size less than 0.125nm can enrich more than 90% of Hg [4-5]. On a global scale , one of the most important factors of increasing of Hg concentration in atmospheric over the past 20 years is the increasing of consumption of coal in the word.

Hg is a metal in the form of liquid at normal pressure and temperature, it has a low melting point, low boiling point, can volatile at room temperature, Hg vapor and Hg compounds are highly toxic. For biology, Hg is a highly toxic element [6]. Hg is easily absorbed by the body, mainly destruction human normal metabolic function, damage to the brain and nervous system. If Hg participate in the biosphere cycle, it will cause serious pollution to the global biological chain, and ultimately endanger the safety of human survival.

China's coal due to coal variety, long coal forming age, coal-forming environment is different, so the Hg content of coal and its occurrence are not the same in the north and south coalfield. Hg is often traceable and traceable in the coal. Among the many pollutants produced by coal combustion, People's understanding is the most superficial for its emission rule and inhibitory mechanism, especially in our country. Therefore, it is very important to study the Hg content and occurrence of coal in Liupanshui area, and it is also important for the Hg removal by coal combustion and correct control and evaluation of Hg release and environmental effect in the process of coal utilization in the region.

Experiment

The coal samples used in the experiment were collected in Liupanshui Miluo coal mine. First, the coal samples were dried and sieved, divided into different size grades, then the coal samples were divided into 8 parts according to the size grade> 50, 50 ~ 25, 25 ~ 13, 13 ~ 6, 6 ~ 3, 3 ~ 1, 1 ~ 0.5,

<0.5mm, next they were crushed, grinded respectively, over 80 mesh and 200 mesh sieve, sealed in a small glass bottle in the dark, The coal samples of each size grade were measured of moisture, ash and sulfur. At the same time, the coal samples which were selected were divided into seven parts of different density 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. The heavy liquid of float and sink was a mixture of zinc chloride and water. Each density grade of coal samples after the float and sink test were obtained after crushed, ground, then they were passed through 80 mesh and 200 mesh sieves, sealed in a small glass bottle in the dark respectively, the water, ash, sulfur of density grade of the coal samples were determined.

Accurately weigh the each size grade, density of coal samples 0.1 ± 0.0001g into the group which had been numbered digestion bottle, added 50% of aqua regia 10ml, shock heated 1h in the 95 ℃thermostat water bath. After added 50% of aqua regia 20ml, 1h after removed the bottle to stand still cooling down to room temperature, then added 1% of potassium permanganate solution 40ml, putted back to 95 ℃ thermostat water bath, heated to digestion until the solution was completely clarified, the solution was determined by filtration and constant volume . The Hg content was determined by AFS-9700 dual channel atomic fluorescence spectrometer.

Results and discussion

Analysis of Raw Coal by XRD . Figure 1 is test pattern of the raw coal by XRD, the scanning step is 0.05, scanning angle range is 5 ° ~ 65 °. The analysis of the material phase showed that the raw coal in Miluo mining area contained quartz, common pyrite, kaolin and so on minerals , contained a small amount of organic matter.

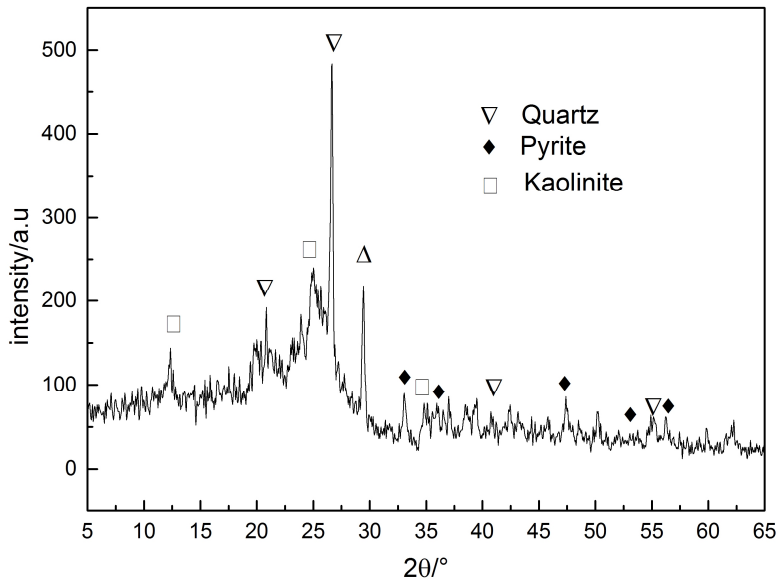

Fig.1 XRD patterns of raw coal in Miluo mining area

Analysis of Hg content and ash and sulfur in different granular coal. Table 1 is the test results of ash, sulfur and Hg content of different grades raw coal in Miluo coal mine, from the test datas can be seen, generally higher ash, the sulfur and Hg content are also relatively high. When the size grade of raw coal is above 50mm, the maximum Hg content is 1.47ppm, at the same time the ash and sulfur are the largest, which is 65.48% and 2.64% respectively. In different size grades of raw coal, Hg content and ash and sulfur showed a strong correlation.

Analysis of Hg Content, Ash and Sulfur in Different Density Grade Coal. The results of ash, sulfur and Hg content of each density of raw coal in Miluo coal mine are shown in Table 2. From the test datas can be seen, with the increase in the density of raw coal, ash, sulfur and Hg content has also increased, when the density is greater than 1.8 g. cm-3, the maximum Hg content was reached to be 1.68 ppm. At the same time the sulfur and ash also measured the maximum, respectively is 2.68% and 45.47%. ash, sulfur and coal density showed a strong correlation.

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

Size grade (mm)	ash A_d (%)	sulfur $S_{t,ad}$ (%)	Hg content (ppm)
+50	65.48	2.64	1.47
50～25	61.76	2.21	1.39
25～13	54.28	2.10	1.09
13～6	39.1	2.56	0.80
6～3	28.67	2.87	1.37
3～1	21.65	2.12	1.42
1～0.5	23.84	2.43	1.12
-0.5	22.73	2.22	1.29

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	17.91	1.92	0.92
1.3～1.4	21.65	2.12	1.12
1.4～1.5	22.21	2.24	1.27
1.5～1.6	35.32	2.39	1.38
1.6～1.7	29.45	2.59	1.47
1.7～1.8	38.09	2.63	1.55
+1.8	45.47	2.68	1.68

Fig.2 showed the relationship between the average density and Hg content of Miluo coal mine. It can be seen from the figure that there is a significant correlation between Hg content and average density, the R^2 of fitted model is 0.9996, there is a good correlation between the fitted model and the actual data.

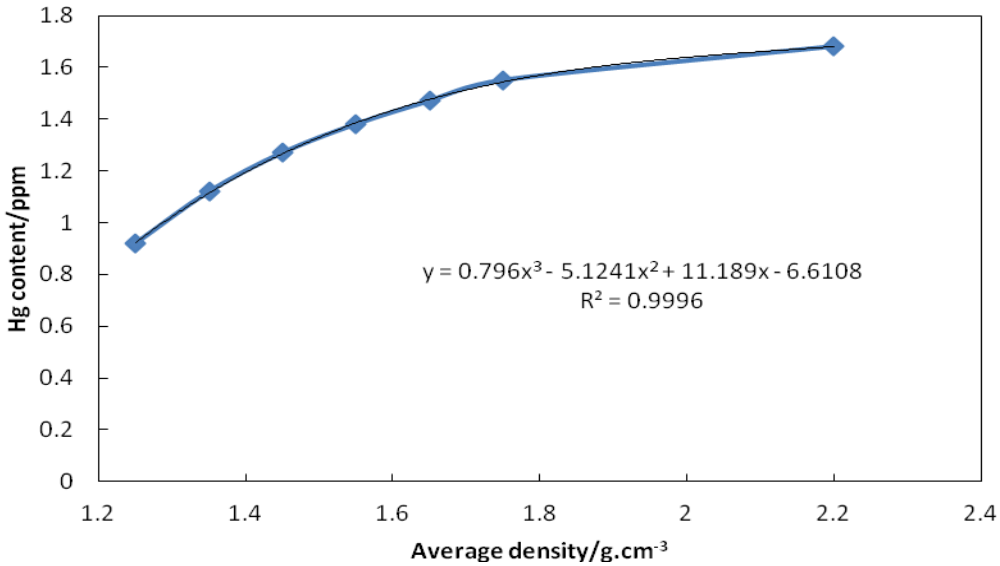

Fig.2 The relationship between the average density and Hg content of the coal

Comprehensive analysis the test results of Hg content, ash and sulfur of different size grade and different density in Miluo 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 Miluo coal mine, the Hg content increases with the sulfur and ash increasing, which indicates that Hg has certain inorganic affinity. The Hg content in the coal is proportional to the density and size of Miluo 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 1.68 ppm. At the same time the sulfur and ash also measured the maximum, respectively is 2.68% and 45.47%.

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