Short communication

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# Determination of mercury content in coal dust collected from coals

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**ABSTRACT.** The problems of coal dust emission are relevant in the coal industry. The greatest danger is represented by coal dust with particle sizes of less than 10 and 2.5 microns. Such fine airborne dust can have a negative impact to human health, susceptibility to weathering, tendency to long-term environment damage, settling on the soils and transferring into waters. The contents of coal dust must be controlled, therefore coal dust was included in the list of pollutants regulated by Hygenic standards GN 1.2.3685-21. It is well known that coal dust may contain potentially hazardous elements, the concentration of which is determined by the form of their occurrence in coal. Among these potentially hazardous elements, mercury compounds are the most dangerous. In this regard, works aimed at assessing the distribution of mercury in coals and airborne dust are relevant. The current paper presents the results on the determination of mercury contents in coals and airborne dust that was collected from them. Also, the granulometric composition of dust particles was shown.

***Keywords***: coal dust, airborne dust particles PM10 and PM2.5, potentially hazardous elements, sieve analysis, mercury content

## 1. Introduction

The emission of coal dust is today an urgent problem in the coal industry. The airborne coal dust with sizes less than 10 and 2.5 μm is of the greatest interest, as it can be suspended in air for a long time and be transported over considerable distances. This has a negative impact on the atmospheric air, soils and water bodies, and can also leads to various diseases of the human pulmonary system, such as fluorosis and selenosis (Dai et al., 2012; Liu and Liu, 2020). Coal dust is included in the list of pollutants in accordance with Hygenic Standards GN 1.2.3685-21 "Hygienic standards and requirements for ensuring the safety and (or) harmlessness of environmental factors for humans" (GN 1.2.3685-21, 2021), therefore, issues related to the control of the content of coal dust are an important task in the coal industry.

The composition of coal dust may include various potentially hazardous elements (PHE), one of which is mercury and its compounds. Mercury, as the most toxic element, has always been of great interest (Zharov et al., 1996). An important feature of mercury compounds is the volatility. The authors note that, as a rule, mercury in coals is present in two forms: mercury associated with inorganic and/or organic matter (Yudovich et al., 2005). Currently, there is no reliable information on the mercury content in coal dust. Therefore, in order to control mercury in coal dust and its emission into the environment, it is necessary to carry out a number of measures aimed at studying the content of suspended dust in coals, its composition, as well as the content and forms of PHE in it.

The current work is dedicated to the determination of the mercury content in samples of coal and fine airborne dust, as well as to the determination of the granulometric composition of airborne dust.

## 2. Materials and methods

The samples of coals from the Kuznetsk basin were used. Sieve analysis of samples was performed in accordance with standard method (GOST 2093-82, 2001). Size class of less than 3 mm was used to collect the airborne coal dust using a specialized laboratory installation (Krasilova et al., 2022a). Table 1 shows the results of proximate analysis of coal samples and dust collected at the laboratory installation.

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## 3. Results and discussion

### 3.1. Determination of the particle size distribution of coal dust by laser diffraction

Granulometric composition of the collected coal dust samples was determined by laser diffraction in accordance with procedure described in (Krasilova et al., 2022b). To determine the particle size distribution, an Analysette 22 Next Nano particle size analyzer (FRITSCH, Germany) was used. The results of determining the granulometric composition are given (Krasilova et al., 2022a). It was shown that the content of particles with sizes up to 10 microns varies between 25.3% and 35.3%, and particles less than 2.5 microns is in the range of 4.7-7.4%.

### 3.2. Determination of mercury content in coals and coal dust

To determine the mercury content in coal dust, a RA-915M mercury analyzer with thermal decomposition of the sample (Lumex) was used. Measurements were carried out in accordance with standard method (GOST R 59176, 2020). The results are given in Table 2 and Fig. 1.

Mercury is found in all samples of coal dust, in amounts not exceeding Clarke values in the earth's crust according to A.P. Vinogradov (Kasimov and Vlasov, 2015). The highest mercury content was noted in dust of coal № 2 - 0.078 g/t, and the minimum - in dust of coal (0.036 g/t). The results of mercury content determination showed that the mercury content in dust samples slightly exceeds its content in coal.

## 4. Conclusions

A proximate analysis of coals and airborne dust collected from them was carried out. It was shown that the dust is characterized by a higher ash content, and the sulfur content in the dust practically does not change relative to coals.

The content of mercury in coals and airborne dust collected from them was determined. It was shown that the contents of mercury in dust samples slightly exceeds its contents in coal.

**Table 1.** Results of proximate analysis of coals and dust samples.

| Sample № | Proximate analysis | | | |
|---|---|---|---|---|
| | $W^t$, % | $W^a$, % | $A^d$, % | $S_t^d$, % |
| Coal №1 | 12.1 | 1.1 | 11.2 | 0.33 |
| Dust of coal №1 | - | 0.8 | 14.0 | 0.31 |
| Coal №2 | 11.4 | 1.4 | 9.1 | 0.28 |
| Dust of coal №2 | - | 1.0 | 10.1 | 0.25 |
| Coal №3 | 11.4 | 1.1 | 8.9 | 0.30 |
| Dust of coal №3 | - | 0.8 | 9.7 | 0.34 |

Note: $W^t$ - total moisture; $W^a$ – analytical moisture; $A^d$ - ash contents (on dry basis); $S_t^d$ - total sulfur (on dry basis).

**Table 2.** Mercury content in coals and dust samples.

| Sample № | Hg (on dry basis), g/t |
|---|---|
| Уголь №1 | 0.049 |
| Coal №1 | 0.050 |
| Dust of coal №1 | 0.074 |
| Coal №2 | 0.078 |
| Dust of coal №2 | 0.036 |
| Coal №3 | 0.040 |

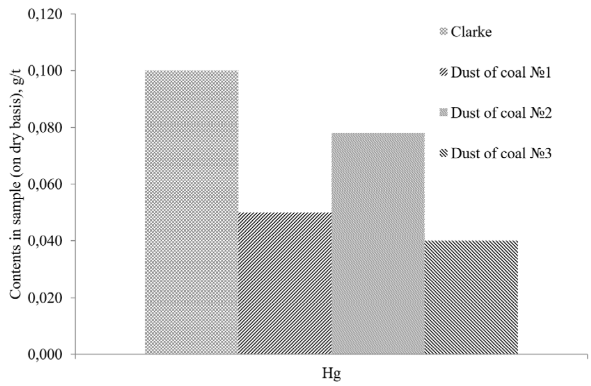


**Fig.1.** Mercury contents in airborne dust.

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## Conflict of interest

The authors declare no conflict of interest.

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