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ENVIRONMENTAL HAZARD DUE TO MERCURY: MERCURY CONTENT IN THE DETRITIC BROWN COAL OF THE TURÓW AND LUBSTÓW DEPOSITS

Specimens of detritic coal from the brown coal deposits of Turów and Lubstów were analysed for mercury content (which was found to range from 0.03 to 0.31 ppm and from 0.13 to 0.49 ppm, respectively). The mercury emission factor for the Lubstów brown coals is noticeably higher than the one established for Belchatów (0.11 g/Mg). The specific pattern of mercury behaviour in various ecosystems makes it difficult to predict the environmental contamination due to this heavy metal when its concentration falls below 1 mg/kg dry wt.

1. INTRODUCTION

The specimens of the detritic brown coal selected for the study came from the vertical profiles of seam II of the Turów Deposit and the lower (II) seam of the Lubstów Deposit. Both are classified as Lower Miocene seams of Poland's Tertiary. Petrographic composition of brown coal of the two deposits is different. The Turów Deposit is characterised by a great variety of lithotypes. Seam II is built of xylo-detritic and detroxylytic coals. It also includes small amounts of xylitic and detritic coal, as well as bituminiferous and semi-bituminiferous lignite. The xylitic coal of the Turów Deposit has been investigated for mercury content in one of our previous studies [1]. In the Lubstów Deposit, the dominating lithotype is detritic coal, whereas xylo-detritic and xylitic coals and semi-bituminiferous lignite occur in small amounts only [2].

References to the mercury content in detritic coal are not very frequent in professional literature and hardly any report is available on what is sometimes defined as 'fresh coals'. Although MATL and WAGNER [3] reported on the concentrations of mercury in the roof, middle and floor parts of the deposits and seams which are described in this study. They used specimens, which included all the lithotypes occurring in a given part of the profile. The highest ($Hg > 4$ ppm) and the lowest ($Hg =$

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0.7 ppm) mercury contents detected by Matl and Wagner were in the middle part of the Lubstów seam and in the floor part of seam II in the Turów Deposit, respectively. The concentrations of mercury in the brown coal of the Turów mine reported by SZPILA and BOJAKOWSKA [4] proved to be considerably different ranging from 0.05 to 2.71 ppm, with geometric mean being 0.23 ppm.

For comparison, it seems worthwhile to mention the investigation reported by HLAWICZKA [5] who measured the mercury content in the brown coal of the Bełchatów Deposit (which ranks first as a source of power generation in Poland). According to these studies, mercury concentration ranges there from 0.08 to 0.205 g/Mg, with a mean value of 0.12 g/Mg.

2. MATERIAL AND METHODS

The specimens were collected from two profiles – seam II of the Turów Deposit (of 15 m thickness) and lower (II) seam of the Lubstów Deposit (of 24 m thickness). For each of the two deposits, 7 specimens were taken from the floor to the roof. Although the specimens consisted of detritic coal, they differed considerably in petrographic terms (the variations were greater in the Turów Deposit). This difference should be attributed to the presence of detritus, fusain, sand or clay inclusions, and different extent of gelification.

The air-dried and brittled material, in approximately 50 mg portions, was analysed with a mercury analyser of AMA- 254 type. Mercury content was determined in the course of sample combustion in a pure oxygen (99.995%) stream, where all mercury compounds undergo degradation. Under such conditions, the determinability of mercury amounted to 0.05 ng.

3. RESULTS AND DISCUSSION

The concentrations of mercury in the detritic brown coal samples from the Turów and Lubstów deposits have been gathered in the table. As shown by these data, there are no big differences in mercury content between two deposits: 0.03 to 0.31 mg/kg dry wt. for Turów (seam II), and 0.13 to 0.49 mg/kg dry wt. for Lubstów.

Although the detritic coals of the Turów Deposit are characterised by different petrographic variations, this has no noticeable effect on the pattern of mercury content. The highest mercury level (0.31 mg/kg dry wt.) was measured in typical moderately compact and partly gelified detritic coal which contains small amount of fusain.

Mercury content in the lower (II) seam of the Lubstów Deposit follows a different pattern; it rises upwards in the profile. Considering the fact that approximately 90% of the mercury contained in the brown coal is released into the atmosphere in the course

of combustion, the emission factor for the Lubstów Deposit is several times as high as that established for the Bełchatów Deposit (0.11 g/Mg) [5]. Needless to say that this implies an increased environmental threat when the Lubstów coal is used for power generation.

Table

Mercury content in detritic brown coal from the Turów and Lubstów Deposits

Deposit	Specimen	Petrographic description*	Hg content [mg/kg dry wt.]
Turów	T1	semi-bituminiferous, greyish-yellow, compact	0.03
Turów	T2	gelified, black, compact, with fine xylite and fusain particles	0.11
Turów	T3	gelified, black, with single xylite interbeddings and clayey stripes	0.03
Turów	T4	partly gelified, brown, with xylite inclusions and clayey stripes	0.04
Turów	T5	greyish-brown, compact, with fine agglomerations of fusain	0.31
Turów	T6	dark brown, compact, partly gelified, with clayey stripes	0.04
Turów	T7	dark brown, with gelified xylites and numerous agglomeration of fusain	0.03
Lubstów	L1	brownish-black, compact, numerous gel spots	0.18
Lubstów	L2	dark brown, stratified, with large amount of detritus	0.18
Lubstów	L3	brownish-black, compact, with small amounts of detritus and gel agglomeration on the break surface	0.13
Lubstów	L4	dark brown, compact, with small amounts of detritus on the break surface	0.14
Lubstów	L5	dark brown, compact, with fine sand imbeddings	0.20
Lubstów	L6	brown, compact, with single gel spots and sand grains	0.49
Lubstów	L7	brown, compact, with single gel spots and sand grains	0.28

*According to the classification proposed by KWIECIŃSKA and WAGNER [6].

However, the specific pattern of mercury behaviour in various ecosystems makes it difficult to predict the environmental contamination due to this species when its concentration falls below 1 mg/kg dry wt.

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ZAGROŻENIE ŚRODOWISKA NATURALNEGO RTĘCIĄ:
ZAWARTOŚĆ RTĘCI W DETRYTOWYM WĘGLU BRUNATNYM
ZE ZŁOŻA LUBSTÓW I TURÓW

Zmierzone zawartość rtęci w próbach węgla detrytowego ze złoża Turów (0,03-0,31 ppm) i złoża Lubstów (0,13-0,49 ppm). W złożu Lubstów zwracają uwagę większe stężenia rtęci. Wskaźnik emisji rtęci dla węgla brunatnego z Lubstowa jest wyraźnie wyższy niż ustalony dla Bełchatowa (0,11 g/Mg).

Specyficzne zachowanie się rtęci w różnych ekosystemach utrudnia przewidywanie środowiskowych skutków zanieczyszczenia w przypadku stężeń poniżej 1 mg/kg s.m.