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## ENVIRONMENTAL HAZARDS DUE TO MERCURY: MERCURY CONTENT IN THE XYLITES OF POLAND'S BROWN COAL MINES AND IN CONIFER WOOD

Xylite samples collected from four Polish brown coal deposits were analysed for mercury content, which was found to vary from 0.02 to 1.19 ppm. Samples of conifer wood were taken and analysed for the presence of mercury, as coniferous trees were the principal starting material for the formation of xylite. The species selected for the study have grown within a 1-ha area and are approximately of the same age. Mercury content in the conifer samples varied from 0.03 to 0.10 ppm. Approximate assessments were carried out in order to establish the contribution of xylites to environmental contamination by mercury during brown coal combustion for power generation.

### 1. INTRODUCTION

The objective of the study was to assess the contribution of xylites to environmental contamination during brown coal combustion for power generation. Xylite is fossil wood of conifers which occurs in brown coal in the form of stems, trunks, stubs and other tree fragments (differently sized). Xylites either have a well-preserved woody texture or are decomposed, preserving their original shape only. Many xylite variation are gelified, fusinitised or (rarely) impregnated with mineral matter. Poland's brown coal seams are made up of xylitic inclusions, interbeddings or small xylitic lumps distributed in the earthy coal mass. Xylite-rich agglomerations like that of the Bełchatów or the Turów Deposit should be classified as lithotypes [1].

References to the occurrence of trace elements in brown coal seams are not very frequent in specialised literature, and hardly any investigators have reported on the presence of trace metals in xylites. Of the toxic elements found in brown coals, mercury shows the highest volatility, which facilitates migration of this species through natural environment [2]. Trace element studies of brown coal specimens from the Konin Deposit by qualitative spectral analysis did not reveal any occurrence of mercury [3]. A study of Canadian Paleocene coals provided a list of 44 trace elements determined when investigating the elemen-

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tal composition of the whole coal, but the list did not include mercury concentration [4]. A number of references [2], [5], [6] provided information on the occurrence of mercury in brown coals. MATL and WAGNER [2] detected mercury in different parts of Polish brown coal seams, and its concentrations were found to vary between 0.6 and 1.9 ppm. These were average coals (both xylitic and earthy). ALEKSANDROV reported [5] that mercury content in the humic substances of the brown coals investigated fell below 0.05 ppm. SEFCIK and PETRIK [6], who investigated the environmental impact of the Novaky brown coal deposit (Slovakia, Upper Nitra), determined very low mercury concentrations (from 0.05 to 0.07 ppm) in different parts of the deposit. It should be noted that the concentrations of trace elements occurring in brown coal samples are determined in fly ash. Thus, the volatility of mercury does not allow any extension of the results to "fresh coal".

## 2. MATERIAL AND METHODS

Samples were collected from four brown coal deposits – Turów, Bełchatów, Adamów and Pałnów (Konin region) – which vary in xylite content from ca 8% (Adamów) to over 35% (Bełchatów, Turów). Conifer wood samples (*Pinus silvestris*, *Pinus strobus*, *Pinus nigra*, *Larix polonica* and *Picea abies*) were taken in the vicinity of the Turawa Lake (Opole District). All species have grown on an area of 1 ha and are of the same age (approximately 50 years). Xylites are made up of well-preserved Tertiary conifer wood fragments, and the species for sampling were selected accordingly. The sampling sites are shown in the map (see the figure).



Location of sampling sites

The sample material (approximately 50 mg weighed portions) was air dried and crushed. Determinations of mercury were carried out in an Hg AMA-254 analyser, following ashing of the sample in the course of analysis (in the apparatus, using a pure oxygen – 99.99% stream) and sorption of mercury vapours on a gold amalgam layer. Thermally desorbed mercury was measured by atomic absorption in the analyser. This method allows determination of all forms of mercury without losses. Under such conditions, the determinability of mercury amounted to 0.05 ng.

### 3. RESULTS AND DISCUSSION

The table gathers the measured values of mercury in xylite and conifer wood samples. The average mercury content in the xylites of Poland's brown coal deposits was found to differ considerably (irrespective of the xylite variation) not only from one region to another, but also within the same seam, ranging from hundredth parts of ppm (a similar pattern was observed in conifer wood samples) to more than 1 ppm (mg Hg/kg dry wt.). The highest mercury levels were measured in some of the xylite samples from Turów (1.19 ppm), Bełchatów (0.80 ppm) and Pałnów (0.62 ppm). They all displayed concentrations higher than the Clarke value for mercury, which is 0.50 ppm.

Table

Mercury content in xylites and conifer wood

Sampling site	Sample	Hg content (mg/kg dry wt.)
Pałnów	Brittle xylite	0.68
Adamów	Coarsely splitting xylite	0.23
Adamów	Fibrous xylite	0.20
Bełchatów	Brittle, partly gelified xylite	0.20
Bełchatów	Finely splitting xylite	0.80
Bełchatów level 801	Brittle, crumbling xylite	0.08
Bełchatów level 601	Finely splitting xylite, stratiformly gelified	0.04
Turów	Brittle xylite	0.62
Turów	Gelified xylite	1.19
Turów seam I	Splitting gelified xylite	0.04
Turów seam II	Solid, partly gelified xylite	0.04
Turów seam III	Brittle xylite	0.02
Turawa	Pine ( <i>Pinus strobus</i> )	0.03
Turawa	Pine ( <i>Pinus nigra</i> )	0.10
Turawa	Pine ( <i>Pinus silvestris</i> )	0.06
Turawa	Larch ( <i>Larix polonica</i> )	0.05
Turawa	Spruce ( <i>Picea abies</i> )	0.03

The variations of mercury content within the same deposit can be attributed to the varying conditions of mercury sorption by organic matter, to the different mercury concentrations in the starting material, and to the presence of mineral matter displaying quite high concentrations of mercury. Our results are similar to those reported by MATL and WAGNER for Polish brown coal deposits [2].

Considering the xylite content of Poland's brown coal deposits and the coal volume delivered to electric power-stations, it may be estimated that the emission of mercury coming from xylites accounts for 10% (at the most) of the total quantity of this species released to the atmosphere in the process of power generation involving brown coal combustion.

#### REFERENCES

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#### ZAGROŻENIE ŚRODOWISKA NATURALNEGO RĘCĄ. ZAWARTOŚĆ RĘCI W KSYLITACH POLSKICH KOPALŃ WĘGLA BRUNATNEGO ORAZ DREWNIĘ DRZEW IGLASTYCH

Zmierzona zawartość rtęci w próbkach ksyliłtów pochodzących z czterech polskich złóż wynosiła od 0,02 do 1,19 ppm. Drewno drzew iglastych pobrano do analizy jako materiał porównawczy do wyjściowego, który zachował się w postaci ksyliłtów. Drzewa te wyselekcjonowano z obszaru 1 ha i były one w tym samym wieku. Zawartość rtęci w próbkach drewna waha się od 0,03 do 0,10 ppm. Dokonano szacunkowej oceny udziału ksyliłtów w skażeniu rtęcią środowiska naturalnego podczas spalania węgla brunatnego w elektrowniach (max. 10%).