CONTENT OF HEAVY METALS IN SOILS OF POLISH CZECH BORDER AREAS

Zygmunt Strzyszcz , Tadeusz Magiera

Institute of Environmental Engineering, Polish Academy of Sciences,
ul. M. Sklodowskiej-Curie 34, 41-819 Zabrze, Poland.

1.Introduction

Southern Poland is most industrialized part of Poland. Here is located hard and brown coal mining industry, coal burning power industry, iron, cooper, lead and zinc metallurgy, coke and cement industry. Close to the industrial centres, in mountains spread along the Polish - Czech border many recreation areas are located. For this reason there is the great interest in the actual state of the natural environment. A long-term industrial impact, especially in 1970's and 1980's when electrofilters were not in common use caused increasing of heavy metal concentration in topsoil and decreasing its pH. Such combination may cause to ecological disaster.

2.Materials and Methods

Soils were investigated in W-E transect from Izera, Karkonosze (mostly in national park), Opava and Silesian Beskidy within the framework of the project concerning a grounds of soil magnetic susceptibility increase as a result of industrial immission. In each forest regional block (called superforestry) located in Silesian, Opole and Lower Silesia Provinces, three to seven soil pits were excavated. The pits were located close to the points of dustfall measurements. In Karkonosze National Park the network was more dense (20 soil profiles). The heavy metal content was determined according to AAS methodology after extraction in 2 M HNO_3. The threshold values given in method description were considered to estimate the soil contamination (Commentary on..., 1987). The samples were taken selectively from individual horizons and subhorizons. Special attention was paid to the topsoil (litter subhorizons) because the heavy metal content in individual subhorizon may markedly differ.

3.Results and discussion

Izera Mts. The studies have shown a considerable concentration of Zn and Pb in topsoil (Tab. 1). In soil profiles a sharp fall of heavy metal content below A_h horizon was observed. The maximum Zn concentration was recorded in O_f subhorizon, whereas the highest Pb concentration was connected with O_h subhorizon and A_h horizon. The Pb content in the litter and A_h horizon exceeds the permissible level. This is the result of pollution influx from Germany and Czechia, as well as from „Turow" power plant. Such interpretation is based on heavy metal content data from high moors (ombrtrophic peats) in Hala Izerska, located 850 m above sea level (Strzyszcz and Chróst, 1995).

Karkonosze Mts. In the soils from Karkonosze National Park, the content of both studied metals was lower than in Izera Mts., but the distribution pattern in organic subhorizons was similar. The Zn concentration in A_h horizon was higher then in O_l (Tab. 1). A characteristic increase of Zn in B horizon is probably connected with the grain-size composition (waste-clay).

Opava Mts. In Opava Mts. Zn predominated over Pb. The distribution of both metals was similar to those observed in Karkonosze Mts. (Tab. 1). This is probably the result of local contamination and transboundary influx from Krnov area (Czech Republic).
Silesian Beskidy Mts. The considerable increase of heavy metal content in the litter was observed in this area (Tab. 1) due to the pollution influx from Northern Moravia (Hlawiczka et al., 1994) but the local influence can not be excluded. In the lower (mineral) part of soil profile the heavy metal content decreased to 62 (Zn) and Pb 37 mg/kg (Pb). Concentrations above 400 mg/kg were recorded in the area close to the Salmopol Pass, where, the industrial immission is complemented by lead contamination from vehicle exhausts (Wisła – Szczyrk road). On the Czech side of the border in Pisek, Jablonkov and Triniec regions, the Pb content was three to five times that of Zn in A_h horizon. The highest Pb content (soluble in 2 M HNO_3) in the forest soils of a given area was 227 mg/kg. The Zn and Cd the content were 56 and 2.29 mg/kg, respectively (Vavricek and Betesova 1994).

4.Conclusions

The distribution pattern of heavy metal in soil profile suggests their anthropogenic origin. The highest heavy metal concentration was observed in organic subhorizons, mostly O_f/O_h or, in some soils, also in A_h. The predominance Pb over Zn observed in some mountain forest soils is determined by altitude and distance from the source of pollution. This effect was observed at altitude over 600 m. was caused by a specific behaviour of Pb compounds emitted to the atmosphere. A considerable part of these compounds is transformed into gaseous and aerosol forms and, therefore, could be transported over long distances as compared to Zn.

5.References

1. Commentary on the ordinance relating to pollutants in soil.//Published by Swiss Federal Office of Environment, Forest and Landscape. 1987. 17 p.
2. Hlawiczka S., Sztyler A., Sandroni S., Cerutti C., Osrodka L., Jarzebski L. Transboundary transport of air pollutants from the Czech republik to Poland through Brama Morawska. // J. Ecol. Chem., 1994. No. 3(1). P. 13-21.
3. Strzyszcz Z., Chróst L. Określenie depozycji niektórych metali ciężkich na przykładzie torfowiska wysokiego na Hali Izerskiej.// Problemy ekologiczne wysokogorskiej częsci Karkonoszy [Fischer Z. (Ed.)]. Oficyna Wydawnicza Instytutu Ekologii PAN. Dziekanow Lesny 1995. P. 123-129.
4. Vavricek D., Betusowa M. Akumulace tezkych kovu (Zn, Pb, Cd, Cr) v jednoylivych slozkach lesnich ekosystemu na nekterych lokalitach beskyd. // Lesnictvi, 1994. No. 40. P. 371-376.

Table 1. Some heavy metal content in individual horizons of Polish mountain forest soils (mg/kg).

Heavy	**Horizon and subhorizon**						
metal	O_l	O_f	O_h	A_h	E	B	C
Izera Mts.							
Zn	46-235	48-365	36-48	21-30	-	12-21	25-52
Pb	67-82	103-215	121-397	137-270	-	20-26	17-28
Karkonosze Mts.							
Zn	22-104	21-108	12-81	7-113	11	7-153	3-57
Pb	50-100	60-150	10-260	10-110	40	10-60	7-50
Opavskie Mts.							
Zn	70-315	40-325	55-445	65-220	-	30-105	-
Pb	15-165	65-175	40-140	40-125	-	15-40	-
Silesian Beskidy Mts.							
Zn	65-150	71-210	59-140	55-130	-	44-80	-

Pb	80-240	90-310	60-400	40-355	-	30-70	-