

SPATIAL AND TEMPOVAL TRENDS IN POPS SEDIMENT CONTAMINATION IN THE CZECH REPUBLIC

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Introduction

The system of water quality monitoring in the Czech Republic is covered by Czech Hydrometeorological Institute in the co-operation with Water Research Institute and some other institution such as River Basin Management companies or Agricultural Water Administration¹.

Methods - Monitoring of water quality in the Czech Republic

The present monitoring network has been developed since 1963. The basic moment was implementation and adoption of relevant EC Directives.

In present 257 sampling profiles exist and cover the area of the Czech Republic. There the samples of water are collected for determination of basic physical-chemical properties, heavy metals, specific organic substances, biological and microbiological parameters twelve times per year. This state network includes also 44 profiles of complex water quality monitoring, where all these parameters are determined in water, sediments, suspended particles and biomass.

As far as POPs under Stockholm Convention they have been measured in surface waters for relatively long time – polychlorinated biphenyls since 1990, HCB and HCHs since 1993, DDT and drens since 1995 and PAHs since 1992. All these compounds have been also determined as a part of monitoring programme since 2000 in sediments and in suspended particles.

This monitoring network covers also the Czech participation in international monitoring programmes such as International Committees for Protection of the Rivers Elbe, Danube or Odra. As far as ground waters, some POPs are regularly monitored there such as PAHs (from 1991) or HCH (from 1997).

On the other hand, few long-time research projects exist and the results from these projects are also suitable sources of information about the contamination of Czech aquatic ecosystems by POPs. The project of the Czech MoE (VaV/650/3/00 Occurrence and movement of hazardous substances in hydrosphere of the Czech Republic) or reasearch projects of the Consorcium RECETOX-TOCOEN & Associates can be mentioned as example of this approach²⁻⁵.

As far as sources of the PCDDs/Fs contamination of the Czech hydrosphere, the most important sources are combustion processes and their products such as fly ash from waste incinerators, wood impregnated by pentachlorophenol, contaminated soils or materials.

The evaluation of POPs contamination of the Czech hydrosphere is a complex process where the results of monitoring and research programmes play a very important role. A lot of POPs sources were stopped during last ten years due to the economical changes in the country. Moreover a lot of new wastewater treatment plants were built during this period. Another reason of observed decreasing trends in POPs occurrence in waters and sediments is found in the more principal ecological politics of government and local authorities.

Results and Discussion

PAHs

Probably the most polluted region is the Ostrava region and the vicinities of some specific industrial sources such as for example the surroundings of company that produced carbon black and lower molecular PAHs (Valašské Meziříčí) or facilities that used the creosote, asphalt or similar products with a high content of PAHs. Large urban areas are important sources of PAHs too.

Organochlorinated pesticides (OCPs)

In general, the level of contamination by organochlorinated pesticides such as DDTs, dieldrins or HCHs is not high and is comparable with other countries. But still there are a few regional or local problems where higher levels of selected OCPs can be determined. The most important sites are the vicinities of former producers of these compounds such as Spolchemie Ústí n/L. (DDTs, HCB) or Spolana Neratovice (DDTs, HCHs, HCB). Higher amounts were also detected in some regions in the middle and south of Moravia (agricultural regions) (HCHs mainly). These Moravian regions are also highly contaminated with dieldrins than other parts of the country, but in general absolute values of this contamination are very low.

Polychlorinated biphenyls (PCBs)

Probably the most important contamination of hydrosphere in the Czech Republic is given by PCBs. Among the main reasons there is a former production in Czechoslovakia and broad and intensive use of technical PCB mixtures in various industrial sectors.

Present evidence of PCBs in hydrosphere is done by:

- PCBs are still used in many technological equipments (technological liquids) and materials
- Huge amounts of PCBs were deposited in dumps
- A lot of sites with PCBs contaminated soils exist
- PCBs can be produced during high temperature processes if chlorine containing materials are combusted
- PCBs are cumulated in various environmental compartments historically, for long time and under various environmental changes than can be redistributed and input to the aquatic ecosystems

The suspended particles play an important role in the PCBs transport in surface water. The concentrations of OCPs decrease in hydrosphere with the exception of γ -HCH in agricultural regions. The increase of B[a]P concentration downstream industrial centres indicates a continuous release of PAHs into the rivers. However the concentration of PAHs has probably started declining in the highly polluted sediments of the river Odra. The PCBs concentrations in sediments decrease slightly or stay at the same level. High concentration of PCBs is still determined in the suspended particles.

Polychlorinated dibenzo-p-dioxins and furans (PCDDs/Fs)

The determination of PCDDs/Fs contents in water is not included to the monitoring programme from the reason of low water solubility. The contamination of surface water is evaluated on the base of determination of PCDDs/Fs in sediments or particles after water filtration. But monitoring of PCDDs/Fs has still more sporadic than regular in the comparison with other POPs.

In general, the lack of information concerning to the PCDDs/Fs contamination of Czech hydrosphere still exists with exception of few industrial sources such as area of chemical company Spolana Neratovice or region where the research projects were performed (region Zlín, Beroun).

Time trends

- Time trends of PCBs and HCB in the Elbe sediment (sampling site Děčín – Hřensko) during the time period 1993 – 2000 were evaluated.
- Content of PCBs in these sediments are relatively stable during whole period with mean value between 100 and 200 ng.g⁻¹. It can be considered as evidence of continuous contamination from still unidentified sources.
- Decreasing time trend of HCB contents from the same sampling site and the same time period is promising, but it is necessary noted that this decreasing is given by the changes of technologies and construction by new, more effective wastewater treatment plant in Spolchemie Ústí n/L. It is a decreasing from extremely high values and these levels are still higher than country mean value.

The results from research projects of R – T & A are summarized in Table 1 and 2. The contents of PAHs, OCPs, PCBs were determined during the whole period 1991 up to date. PCDDs/Fs were determined in the years 1995, 1996, 1998 and 2001, but the number of sampling sites was lower. In some cases (1998) also oxy-PAHs, azarenes and nonylphenols were determined.

Table 1: Statistics of the POPs concentrations [$\text{ng}\cdot\text{g}^{-1}$] in sediments on the reference areas of R-T&A¹⁻⁵

| Reference Area | Parameters | N | Mean | S.D. | Median | 25 % kvantil | 75 % kvantil |
|------------------------|----------------|----|-------|-------|--------|--------------|--------------|
| Beroun (2001) | suma DDXs | 16 | 7,7 | 4,9 | 6,0 | 4,3 | 10,6 |
| | gama-HCH | 16 | 0,3 | 0,3 | 0,2 | 0,1 | 0,3 |
| | benzo(a)pyrene | 16 | 235,2 | 282,7 | 105,6 | 28,2 | 353,4 |
| | suma PCBs | 16 | 31,4 | 34,9 | 14,9 | 8,4 | 47,0 |
| Košetice (1996 - 2001) | suma DDXs | 41 | 9,2 | 11,5 | 4,5 | 1,5 | 15,6 |
| | gama-HCH | 41 | 0,4 | 0,7 | 0,2 | 0,1 | 0,3 |
| | benzo(a)pyrene | 41 | 13,6 | 9,0 | 11,5 | 7,3 | 18,4 |
| | suma PCBs | 41 | 2,8 | 1,4 | 2,6 | 1,6 | 3,7 |
| Zlín (1996 - 2001) | suma DDXs | 20 | 8,5 | 11,2 | 4,0 | 2,3 | 9,2 |
| | gama-HCH | 20 | 0,4 | 0,6 | 0,1 | 0,0 | 0,2 |
| | benzo(a)pyrene | 21 | 913,7 | 798,5 | 661,8 | 430,0 | 1135,1 |
| | suma PCBs | 21 | 53,9 | 44,4 | 37,8 | 14,2 | 76,8 |

Sum of DDXs: p,p'-DDT, p,p'-DDD, p,p'-DDE; Sum of PCBs: 28, 52, 101, 118, 138, 153, 180

Table 2: Levels of PCDDs/Fs and DL PCBs on the reference areas of R-T&A¹⁻⁵

| Sampling locality Characteristics | Number of sampling sites | Sampling period | PCDDs/Fs | TEQ | DLPCBs (77+126+169) | TEQ DL PCBs |
|--|--------------------------------|-------------------------|-----------------------------------|---------------------------------|----------------------------------|---------------------------------|
| | | | | | | |
| Košetice, Middle European POPs background site | 7 | 1996-2001* | 128.41 n = 1 | 1,4 n = 1 | 8.97 n = 1 | 0.185 n = 1 |
| Zlín, industrial agglomeration (industrial, agricultural and background sites) | 5 | 1993; 1996 - 8; 2001 | 60.8 (1.13 – 463.4) n = 15 | 1.64 (0.9 – 5.6) n = 5 | 0.13 (0.01 - 152.6) n = 17 | 0.4 (0.11 - 1.6) n = 5 |
| Beroun, industrial agglomeration (industrial, agricultural and background sites) | 16 | 2001 | 200.1 (30.3 – 1 105) n = 16 | 1.83 (0.21 – 11.2) n = 16 | 87.7 (11.2 – 1 217) n = 16 | 0.69 (0.11 – 8.37) n = 16 |

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