

WFD priority substances in biota and sediments of rivers in Czech Republic

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Introduction: To achieve the objectives of the Water Framework Directive for assessing chemical contamination was involved the use of integrative matrices – biota and sediment. We have compared concentrations of selected priority substances (PAHs, DEHP, HCB, HCBd, PBDEs, Hg) measured in sediments (sampled twice per year), benthos and juvenile fishes (sampled once per year). Samples were claimed at 20 matched sites located all over the Czech Republic during years 2011 - 2013.

First goal was to show distribution of compounds in various matrices and the second one to compare values with environmental quality standards (EQS) given by EU legislation.

Methods: Sediment contamination is assessed as year based median value counted for dry matter. For biota were used concentrations in wet mass. Evaluation of environmental relevance of measured concentrations is based on EU directive 2013/39/EU [1] and Government regulation 23/2011 Sb [2] and their EQS for biota and sediments (concentrations in sediments were normalized on TOC content).

Non-parametric statistics has to be used for computations. Median and Mann-Whitney U test with Kruskal-Wallis Anova were used for description and comparisons of data. Values under limit of detection (LoD) were treated as 0.5*LoD.

Results: For each combination of parameter and matrix was computed median value. These values are given in table 1. In this table can be observed which compounds are more concentrated and if they exhibit risk of biomagnification in living organisms.

Highest concentration of HCB and Hg were 1500 ug/kg and 21.5 mg/kg respectively for sediments, 37.4 ug/kg and 0.36 mg/kg for benthos and 77.6 ug/kg and 0.46 mg/kg for fish. EQS was exceeded repeatedly in region of NE Bohemia (chemical industry and old burdens) and occasionally on sites under agglomeration cities with developed industry. PBDEs (PBDE 28, 47, 99, 100, 153, 154) were in sediments mostly under LoD (93% of values). In benthos and fish juveniles were concentrations 2-3 times higher (see tab.1).

HCBd (hexachlorobutadiene) was over LoD only at several localities. The highest concentration was 240 ug/kg in Bilina river.

Tab.1: Median concentrations of parameters sampled in two consecutive years¹.

median	Benthos	Juvenile fish	Sediment
Hg [mg/kg]	0.14	0.21	0.45
PAHs [ug/kg]	182.00	10.55	1212.00
HCB [ug/kg]	2.10	2.05	2.50
PBDEs [ug/kg]	4.11	5.59	<2
DEHP [ug/kg]	380.00	280.00	835.00
PFOS [ug/kg]*	28.60	57.60	n.a.

¹ HCBd not evaluated – medians are <LoD

* PFOS sampled only in biota

DEHP (di-(2ethylhexyl)phthalate) concentrations varies greatly between years. In general, the concentrations are highest in sediment. However EQS was not exceeded even at the highest concentration 60 200 ug/kg measured in Bilina.

PAHs have exceeded EQS at several sites both in industrial / city and less impacted ones. Regularly are PAHs present in higher concentration in the basin of Morava, Dyje and Odra. The highest measured concentration in sediments was 10 660 ug/kg in Bohumin, 5 530 ug/kg in benthos (both Odra river) and 168 ug/kg in fish (Dyje river).

Discussion: It was revealed that each type of chemical behaves differently in the environment. Distribution of Hg significantly differs among matrices ($p < 0.001$). The same situation is for PAHs, where lowest concentrations are in fish and highest in sediment. Then the sediment seems to be the best indicator for these two parameters.

HCB was found at similar levels in all three compartments ($p=0.922$), however it is needed to point out that extreme concentrations can occur.

Concentrations of DEHP are significantly higher in sediments than in biota ($p < 0.003$). But if we compare each year separately, the differences diminish in some years. EQS exceedings were addressed in results.

References: [1] 2013/39/EU, 12 Aug 2013, as regards priority substances in the field of water policy. [2] Narizeni vldy, kterym se meni narizeni vldy c.61/2003 Sb., 17 Feb 2011