

Levels of PBDE in Sediments Along the Course of the River Danube Through Austria

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Introduction

Polybrominated Diphenylethers (PBDE) are widely used as flame retardents and are regarded as persistent in the environment and bioaccumulative in humans and wildlife^{1,2,3}. Therefore in 2001 the Federal Environment Agency Austria on behalf of the Chemical Inspectorate carried out a first survey of the use of Brominated Flame Retardents in Textiles and Plastics. As a follow up in 2002 a study on the occurrence of BFR in the aquatic environment of Austria was carried out⁴.

A first rough overview about the results from that study was presented at the Dioxin Symposium 2003⁵. This presentation gives the detailed evaluation of PBDE concentrations in sediments of the river Danube.

Methods and Materials

The sampling of 13 sediment samples and 2 samples of suspended particulate matter (SPM) was done within the frame of the project JDS 2001 (Joint Danube Survey) with the exploration ship Argus at 8 sites along the 320km course of the river Danube through Austria⁶.

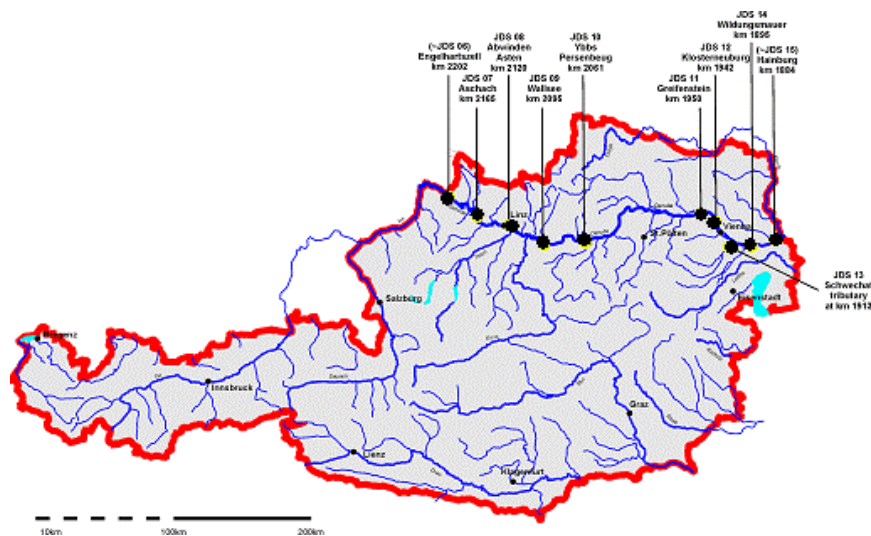
Picture 1 shows the course of river Danube and the positions of the sampling sites. At 5 sampling sites Aschach, Asten, Ybbs, Greifenstein and Wildungsmauer" sediment samples were taken near the left and right banks of the Danube River. At the site Wallsee the sediment sample was taken near the left banks, at site Klosterneuburg near the right banks.

The sampling sites Aschach, Asten, Ybbs and Greifenstein are within the area of a water power plant, the sites Klosterneuburg and Wildungsmauer lay within a free running sections of the Danube River.

The sampling site Schwechat is situated in the mouth of the river Schwechat into the river Danube, where the effluents of a waste water treatment plant which cleans municipal waste water from the city of Schwechat and industrial waste water from the Vienna airport, petrochemical industries, plastics producing industries and a brewery.

Suspended particulate matter was collected between the villages Engelhartzell and Aschach and between the villages Ybbs and Melk. The water was centrifugated on board of the ship to separate the suspended particulate matter from river water.

Picture 1. Sampling Sites within the project Joint Danube Survey:



The sample amounts used for analysis were 10 g freeze-dried solid sample. The analytic method used, published by W.Knoth et al.², includes Soxhlet extraction, cleanup by 4 steps of column liquid chromatography and measurement with a GC/HRMS System. The quantification was done by isotope dilution with 7 ¹³C-labeled standards, which were added prior to extraction. The detection limits are in the range between 0.1 and 2 ng/kg. A total of 18 PBDE congeners were analysed.

Results and Discussion

PBDEs were detected in all 15 samples of the river Danube. With the exception of the sediment sample from the region of Schwechat the concentrations of PBDE, which are given in Table 1 and shown in Picture 2, are relatively constant along the river. The PBDE concentrations were below 10 ng/kg_{DM} for most of the congeners except BDE-47, BDE-99, BDE-100, BDE-153, BDE-154, BDE-181 and BDE-183 which show concentrations up to 270 ng/kg_{DM}. The highest concentrations could be found at the industrialised site Schwechat with 3500 ng/kg_{DM} for BDE-47 and 4000 ng/kg_{DM} for BDE-99. The influence of the region Schwechat was also visible downstream at the site Wildungsmauer especially for the congeners BDE-181 and BDE-183. Surprisingly no influence of the highly industrialised city of Linz, which is situated upstream of the sampling site Asten could be seen.

The congener BDE-181 was detected in all samples downstream of the site Ybbs with concentrations up to 430 ng/kg_{DM} at the site Wildungsmauer.

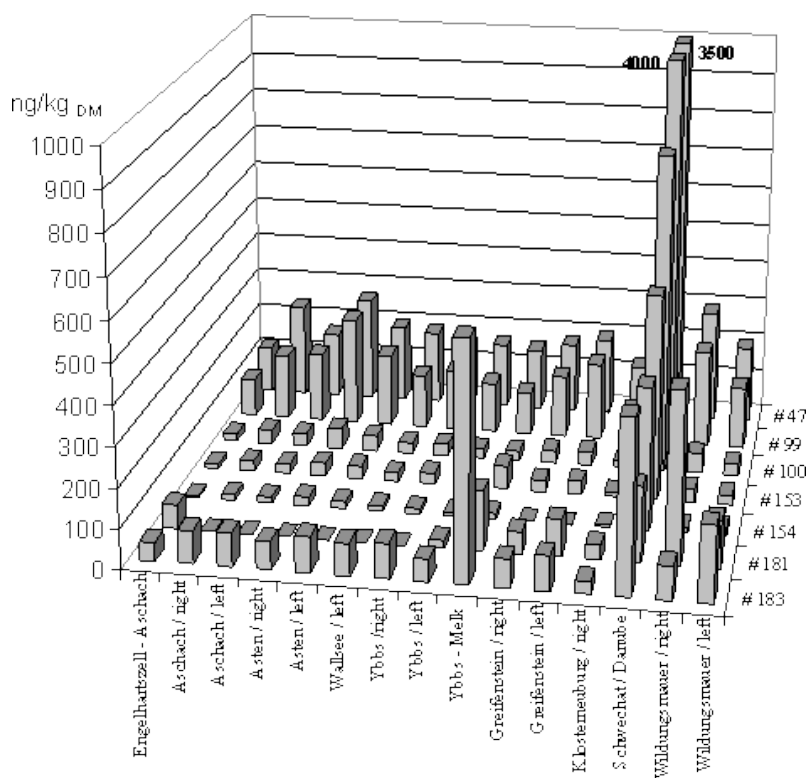
The concentrations of PBDE in solid particulate matter, which are shown in picture 2, were similar to those in the sediment samples for congeners with a lower degree of bromination. Congeners with a higher degree in bromination showed higher concentrations in the solid particulate matter than in sediments. Especially the sample collected between Ybbs and Melk showed high concentrations for the congeners BDE-181 (150 ng/kg_{DM}) and BDE-183 (590 ng/kg_{DM}) which are similar to those in the sediment sample of the region Schwechat. The reason for this is still not known.

Table 1. Concentrations of PBDE in sediment samples from 8 sampling sites along the course of the Danube are given. At some sites samples have been taken near the right and the left banks. In these cases the median concentration of both samples is shown in the table.

PBDE ng/kg _{DM}	Aschach	Asten	Wallsee	Ybbs	Greifen- stein	Kloster- neuburg	Schwechat	Wildungs- mauer
# 11	0.10	ND	ND	0.030	0.12	0.10	ND	ND
# 17/25	2.8	5.4	1.3	2.5	4.0	1.0	45.0	3.7

# 28	6.1	7.9	6.3	6.5	5.3	4.7	110.0	9.5
# 47	205	235	190	165	190	130	3500	245
# 49	15	26	16	11	17	6.0	320	23
# 77	0.39	ND	0.18	0.26	0.36	0.18	2.4	0.15
# 99	175	235	140	145	180	80	4000	205
# 100	36	47	28	28	35	19	810	42
# 116	ND	ND	ND	ND	ND	ND	ND	ND
# 138	4.1	4.8	1.1	2.5	5.6	2.1	93	5.8
# 140	2.1	2.3	ND	1.0	2.2	1.5	30	3.7
# 153	27	35	23	27	32	11	520	30
# 154	15	21	14	12	2.4	5.6	360	18
# 155	1.6	1.8	1.3	1.0	1.4	0.8	17	0.9
# 166	ND	ND	ND	ND	ND	ND	ND	ND
# 181	ND	ND	ND	11	75	38	190	275
# 183	83	81	81	72	79	32	430	138

Picture 2. Concentrations of the 7 most abundant congeners along the river course through Austria



Conclusions

PBDEs could be found in all sediment and solid particulate matter samples of the river Danube, even though in low concentrations. Relatively high concentrations were detected in the sediment sample from the high industrialised region of Schwechat, where the influence of the treated wastewater on the river sediments could be seen very clearly.

References

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