ANTHROPOGENIC BROMINATED AROMATICS IN THE SWEDISH ENVIRONMENT

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INTRODUCTION

Brominated flame retardants have previously been reported in samples from the Swedish environment, pentabromotoluene in sewage sludge (1), polybrominated diphenyl ethers (PBDE) in fish (2), and PBDE and polybrominated biphenyls (PBB) in seal and sea eagle (3).

The results from some recent investigations of brominated flame retardants are presented in this paper.

SEDIMENT SAMPLES FROM A USER SITE

Sediment samples taken upstream and downstream from a factory were analysed for tetrabromobisphenol A (TBBP-A), its dimethylated derivative (Me_2-TBBP-A) and polybrominated diphenyl ethers (PBDE). Extraction and clean-up of sediments and sewage sludge were performed according to a method described earlier (4), with some minor modifications.

Table 1. Levels of some compounds found in sediment outside of a factory (ng/g ign.loss).

COMPOUND	UPSTREAM	DOWNSTREAM
TBBP-A	50	430
Me_2-TBBP-A	36	2400
2,2',4,4'-TeBDE	3.5	840
2,2',4,4',5-PeBDE	8.2	1200

For all analysed compounds, the levels downstream were higher than the levels upstream.

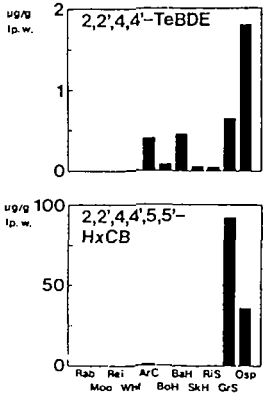
BIOLOGICAL SAMPLES

A multiresidue method for analysis of organohalogen pollutants (5) was applied to some selected biological samples from the Swedish environment (Table 2). In this application, a great number of different substance groups were analysed in each sample. This makes direct comparisons possible, without having to take into consideration the problem of different samples.

Table 2. INVESTIGATED SPECIES

RABBIT (southern Sweden)	HERRING (Bothnian Sea)
MOOSE (southern Sweden)	HERRING (Baltic Sea)
REINDEER (northern Sweden)	HERRING (Skagerrak)
WHITEFISH (northern Sweden)	RINGED SEAL (Spitzbergen)
ARCTIC CHAR (southern Sweden)	GREY SEAL (Baltic Sea)
OSPREY (Sweden)	

Each sample was a pool from several individuals and duplicate samples were analysed. Except for the ringed seal from Spitzbergen, all samples came from the Swedish environment. One of the fresh water fish samples came from an industrial area (arctic char), and the other from a non-industrialised area (whitefish).



Different profiles are seen for the major PBDE and one of the major PCB. The levels of PBDE do not differ as much between different species as do the levels of PCB, where the levels in grey seal and osprey stand out.

In grey seal and its major food item, Baltic herring, the levels of PBDE are almost the same, while for the PCB the difference in levels is considerable.

Figure 1.

Some detected compounds in the Baltic seal sample are shown in Table 3.

Table 3. Compounds found in GREY SEAL from the Baltic Sea.

COMPOUND	CONC. ng/g lp.w.		
TOT-PCB	550 000	Chloroparaffins	280
TOT-DDT	270 000	Hexachlorobenzene	220
PCB, IUPAC 153	92 000	Hexabromobiphenyl	26
PCC (Toxaphene)	5 700	Planar PCB	5
Chlordane	4 000	Polychl. naphthalenes	1
PBDE, sum of 3	730		

SEWAGE SLUDGE

The commercial flame retardant Bromkal 70-5DE contains three major components. The pattern of these three congeners in sewage sludge is almost identical to that of the commercial mixture. In biological samples, however, the tetrabrominated diphenyl ether dominates, Table 4.

Table 4. Relative concentrations of PBDE congeners in some samples, %.

	2,2',4,4'-TeBDE	PeBDE	2,2',4,4',5-PeBDE
Bromkal 70-5DE	44	8	48
Sewage sludge	40	9	51
Grey seal	89	5	6

The levels of single PBDE congeners in sewage sludge are comparable to single congeners of the DDTs and the PCB, Table 5.

Table 5. Levels of some compounds in sewage sludge.

COMPOUND	CONC. ng/g ign.loss
2,2',4,4'-TeBDE	15
PeBDE	3.4
2,2',4,4',5-PeBDE	19
DDE	10
DDD	12
DDT	46
PCB, IUPAC 28	5.9
PCB, IUPAC 52	9.1
PCB, IUPAC 101	16
PCB, IUPAC 138	24
PCB, IUPAC 153	19
PCB, IUPAC 180	11

TIME TREND ANALYSIS

A sediment core was taken in the southern part of the Baltic Sea. The laminated core was sliced into 0.5 cm sections down to 5 cm depth, and in 1 cm sections down to 9 cm depth. Dating of the core by varve-counting suggests the material at 4 cm depth to be from 1973.

Analysis of cores of laminated sediments in combination with dating of the different levels in the cores, is useful for time trend analyses of the pollution situation. Low levels of PCB and DDT compounds were found, and we were not able to detect any planar PCB or PCN

Brominated diphenyl ethers

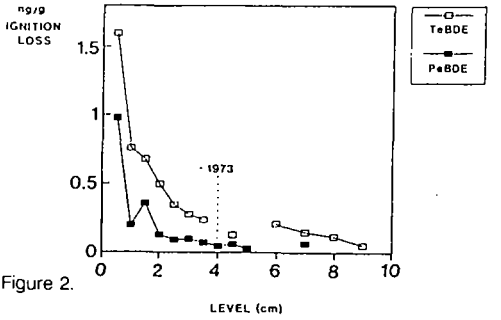


Figure 2.

The investigated sample shows slightly increasing PCB concentrations since the early seventies, while there does not seem to be any significant change in DDT levels during this period. The concentrations of PBDE do, however, increase dramatically during the same period.

A time trend study made on guillemot eggs from Stora Karlsö in the Baltic Sea, seems to confirm this increase.

CONCLUSIONS

Investigations from different parts of Sweden, from both aquatic and terrestrial environments in background as well as industrialised areas have shown that polybrominated diphenyl ethers are widespread in the Swedish environment. The levels are highest near user sites and the environmental levels seem to have increased since the 1970s.

REFERENCES

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