



Brominated Flame Retardants in Drammens River and the Drammensfjord, Norway

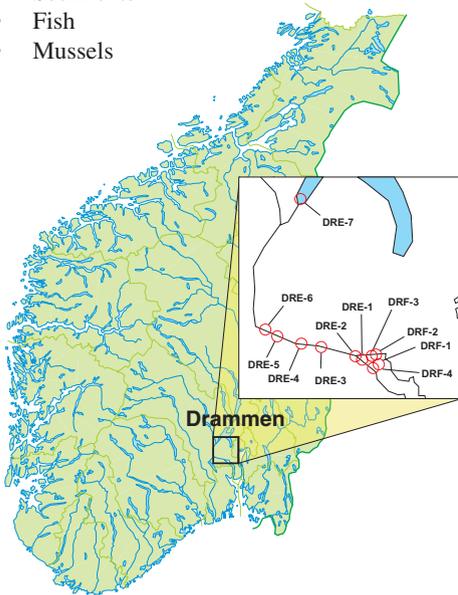
Martin Schlabach¹, Eirik Fjeld² and Anders R. Borgen¹

¹Norwegian Institute for Air Research, Instituttveien 18, P.O. Box 100, NO-2027 Kjeller, Norway

²Norwegian Institute for Water Research, Brekkeveien 19, NO-0884 Oslo, Norway

Introduction

- Screening survey of BFRs
- Highlighted area
- Sediments
- Fish
- Mussels



Materials and Methods

7 Stations

Sediments:

- 0–2 cm
- Internal stds: ¹³C-, PBDEs, TBBPA, PCBs
- Soxhlet extraction
- GPC

Biota:

- Pooled samples (5–20 individuals)
- Na₂SO₄ homogenisation
- Internal stds: ¹³C-, PBDEs, TBBPA, PCBs
- Cold column extraction
- GPC

TBBPA: Derivatisation with MSTFA

Analysed on HRGC/MS and LC/TOF (HBCD)

Results and discussion

Sediments

The contamination of PBDEs in sediments from Drammens River and the Drammensfjord are dominated by the fully brominated BDE-209. The highest concentration was found at the station highest up in the river at the outlet of lake Tyrifjorden, in a presumptive rather unpolluted area. This station should be resampled to confirm this level. In the Drammensfjord the highest level of PBDE was found outside a quay for shipping of materials (shredding) from recycled automobiles. BDE-209 dominated the concentrations in both river and marine sediments (80–99%). Sediments from the Drammens River had concentrations of TBBPA in the range of 0.02–10 ng/g d.w., with

the highest concentration close to an industrial area. Sediments from the Drammensfjord had concentrations of TBBPA in the range of 0.3–39 ng/g d.w., with the highest level close to an industrial area. Detectable concentrations of α -HBCD (0.9–1.5 ng/g d.w.) and γ -HBCD (0.3–3.1 ng/g d.w.) were found in the Drammens River. In the Drammensfjord, detectable concentrations of all three isomers were found at one station close to an industrial area (concentration of α -, β -, and γ -HBCD were 10.2,

0.7 and 3.3 ng/g, respectively). In the Drammens River, the concentrations of SCCP+MCCP varied between 10–7,400 ng/g d.w., with increasing concentrations downstream. In the Drammensfjord the concentrations were in the range of 750–7,750 ng/g d.w., with the highest concentrations close to a floating dock. The concentrations of PBDEs, TBBPA, HBCDs and CPs in sediments from Drammen River and the Drammensfjord are shown in table 1.

Table 1. The concentrations of PBDEs, TBBPA, HBCDs and CPs in sediments from Drammens River and the Drammensfjord (downstream, top to bottom). The concentrations are reported in ng/g dry weight.

Station ID	Station name	PBDE ng/g dry weight										ng/g dry weight	HBCD ng/g dry weight			CP ng/g dry weight			
		BDE-28	BDE-47	BDE-97	BDE-77	BDE-99	BDE-100	BDE-119	BDE-153	BDE-154	BDE-183		BDE-209	TBBPA	α -HBCD	β -HBCD	γ -HBCD	SCCP	MCCP
DRE-7	Vikersund	<0.01	0.02	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	79.27	0.02	<0.1	<0.08	<0.12	12	0.8
DRE-6	Loselva	0.05	0.91	0.20	0.01	2.04	0.31	0.11	0.91	0.27	0.27	54.44	9.96	0.33	<0.08	0.27	180	280	
DRE-5	Hokksund	0.02	0.17	0.03	<0.01	0.19	0.04	0.02	0.03	0.02	0.02	5.59	0.29	0.09	<0.08	0.36	16	6.2	
DRE-4	Mjondalen	<0.01	0.37	0.03	<0.01	0.47	0.09	0.15	0.06	0.03	0.03	4.83	0.81	0.99	0.07	3.08	150	100	
DRE-3	Langesøya	<0.01	0.16	0.02	<0.01	0.22	0.05	<0.01	0.02	0.02	0.02	3.55	0.28	0.15	<0.08	0.25	150	380	
DRE-2	Polthuset	0.01	0.17	0.03	<0.01	0.32	0.05	0.08	0.05	0.04	0.04	9.36	0.72	1.55	<0.2	0.85	430	1400	
DRE-1	Jernbanebraua	0.04	0.68	0.15	<0.01	1.29	0.23	<0.03	0.28	0.15	0.15	32.18	1.59	0.78	<0.2	0.32	1800	5600	
DRF-1	Hovedbasseng	0.01	0.14	0.08	<0.01	0.14	<0.01	<0.01	<0.04	<0.03	<0.03	6.89	1.29	<0.3	<0.2	<0.4	94	140	
DRF-2	Lierterminalen	<0.01	0.17	0.04	<0.01	0.36	0.06	0.01	0.06	0.06	0.06	12.61	0.75	10.15	0.65	3.34	440	350	
DRF-3	Teigen kaianlegg	0.02	0.41	0.11	<0.01	0.79	0.13	0.03	0.19	0.11	0.11	31.71	39.16	<0.3	<0.2	<0.4	1300	220	
DRF-4	Tangen flytedokk	0.01	0.24	0.07	<0.01	0.32	0.05	<0.01	0.04	0.04	0.04	7.47	0.34	<0.3	<0.2	<0.4	250	7500	

Fish

In the fish samples from the Drammensfjord, BDE-47 was dominating among the congeners with 41–72%, with BDE-100 as second (9–22%). The percentage of BDE-99 was low in orfe, cod, flounder and eel (0.3–5%), but relatively high in trout and perch (14 and 31%). TBBPA was only detected in one sample (eel) with a concentration just above the detection

limit. In fish from the Drammensfjord there were in general low concentrations of α -HBCD (5–23 ng/g lipid). Fish from the Drammensfjord had concentrations of SCCP+MCCP between 46–495 ng/g lipid. The lowest concentration was found in an eel sample, the highest in a sample of flounder liver. The concentrations of PBDEs, TBBPA, HBCDs and CPs in fish from the Drammensfjord are shown in table 2.

Table 2. The concentrations of PBDEs, TBBPA, HBCDs and CPs in fish samples from Drammens River and the Drammensfjord. The concentrations are reported in ng/g lipid weight.

Sample	% lipid	PBDE ng/g lipid weight								ng/g lipid weight	HBCD ng/g lipid weight			CP ng/g lipid weight	
		BDE-47	BDE-49+71	BDE-99	BDE-100	BDE-119	BDE-153	BDE-154	TBBPA		α -HBCD	β -HBCD	γ -HBCD	SCCP	MCCP
Perch (muscle)	1.19	74.0	26.9	30.4	24.2	1.3	4.0	4.9	-	22.3	<2.5	<3.4	490	<17	
Orfe (muscle)	0.89	108.5	5.9	0.5	24.9	1.3	8.6	8.4	<300	14.8	<3.4	<4.5	190	250	
Flounder (liver)	7.68	86.8	6.0	7.8	24.4	5.3	3.1	5.0	-	7.2	<0.9	<2.6	530	230	
Cod (liver)	43.70	29.0	3.0	1.6	4.5	0.2	0.2	1.1	<9	9.3	<0.9	<0.3	69	<2	
Trout (muscle)	6.71	11.7	3.5	3.3	2.2	0.4	0.5	1.2	<5	<1.9	<1.3	<0.2	78	<6	
Eel (muscle)	19.80	7.6	0.6	0.4	1.9	0.1	0.3	0.4	0.3	4.7	<0.9	<2.8	41	<9	

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