Poster 1170

M Frederiksen*, K Vorkamp, JB Nielsen, LS Sørensen,
TF Webster, M Vazakas, JA Sørensen & LE Knudsen

DANISH BUILDING RESEARCH INSTITUTE
AALBORG UNIVERSITY COPENHAGEN

Human exposure to novel brominated flame retardants –from materials to humans

Introduction

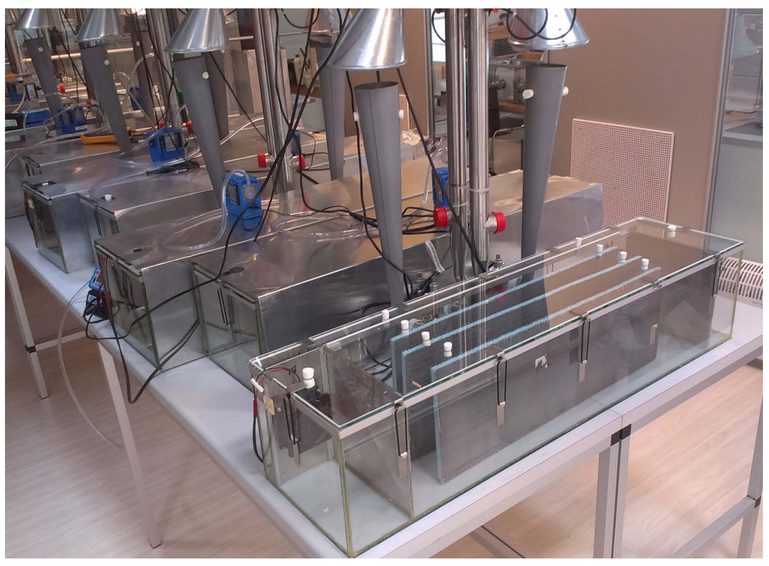
After the phase out of PBDEs novel flame retardants are increasingly used. Some of these flame retardants are: **DBDPE**, **BTBPE, DPTE**, **EH-TBB**, **BEH-TEBP**. Little is known about their presence in the indoor environment and the resulting human exposure. Therefore the current project investigates how the compounds are emitted from construction materials and end up in humans. The project investigates the following pathways and compartments: Emission from construction materials, dermal uptake and transport across the dermal membrane, house dust and breast milk.

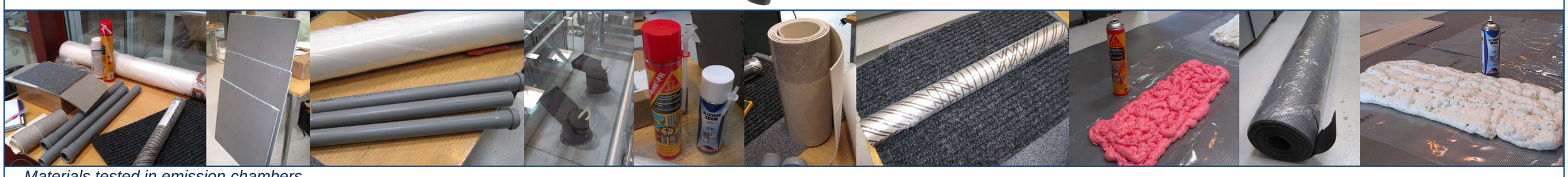
Material emissions

Material/Item	Interval of XRF reading for Br (ppm)
Halogen spotlight casing	>10000
XPS construction board	>10000
Wall paper	10-100
Parquet underlay, XPS	500-1000
Drain pipes	5000-10000
Floor mat	10-100
Vapour barrier	>10000
PU foam (pressurised bottle)	1000-10000
PU foam, fire retardant (pressurised bottle)	Not available
Vinyl flooring	<LOD
Fire retardant carpet	<LOD

A handheld XRF was used to screen materials prior to chamber experiments at suppliers of construction materials, furniture and textiles. More than 300 items were tested, Br >1000ppm was found only in 7 items (none in textiles and furniture). Lower levels (100-1000ppm), which is likely to be too low for flame inhibition, were found in 20 items.

Emission tests are performed in 50L CLIMPAQ chambers under constant air change and temperature. For air sampling sorbent tubes with PUF and XAD-2 resin were used. An airflow of 1,9L/min (±10%) was applied for 24h. Samples have been taken after week 1, 2, 3, 4, 6, 10, and will continue.





Materials tested in emission chambers

Dermal Uptake

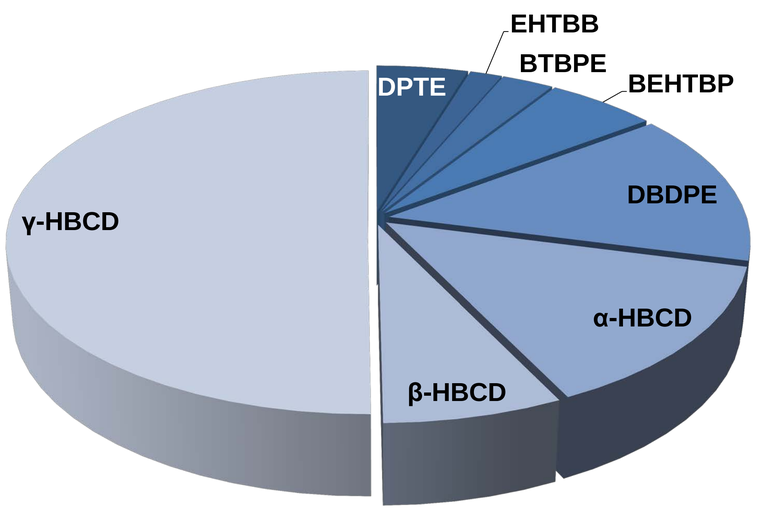
The importance of dermal uptake is unknown for a wide range of POPs including NBFRs, but is important particularly for exposure and risk estimates. Therefore a dermal uptake setup utilising human skin was included in the current project.

Dermal uptake and transport across the dermal membrane is estimated using static diffusion cells. The cells consist of a 16ml receptor chamber on top of which a piece of human skin (4x4cm) is placed; on top of the skin a donor chamber is mounted into which the test compounds are added (dissolved in ethanol).

The receptor chamber contains a NaCl-buffer solution with human serum albumin and hexamycin. The samples are kept at appr. 32ºC under constant stirring, the experiments run for 72h after application. After the end of the experiments, the following compartments are analysed for NBFRs: residual in donor chamber, top layer of skin (stratum corneum and top of epidermis), dermis and the receptor fluid.

Preparation and mounting of skin in diffusion cells, diffusion experiment and separation of epidermis from dermis with a scalpel.

House dust and breast milk



Relative distribution of NBFRs in Danish house dust.

House dust was sampled using vacuum cleaner bags from the homes of new mothers at the same time matching breast milk samples were collected. The majority of samples (n=37) were collected in 2007 and were originally used for analysis of PBDEs, in addition 5 new sample sets were collected in 2014.

The novel BFRs were detected in all samples from 2007 analysed so far (n=5). Apart from HBCDs, DBDPE was the dominating NBFR found in Danish house dust, which is similar to other European findings[1,2]. DBDPE-levels were in same order of magnitude as BDE-209 previously measured in the samples and higher than Σ_{penta}BDE[3].

(n=5)	Median	Range
DPTE	8.2	5.2-85
EHTBB	7.3	4.2-18
BTBPE	5.9	2.8-67
BEHTBP	24.8	13-75
DBDPE	87.3	32-139
α-HBCD	99.0	6.7-138
β-HBCD	52.2	2.5-71
γ-HBCD	287.0	12-646

Preliminary results of NBFRs in Danish house dust (n=5)

References: [1]Sahlström et al. (2012) Anal Bioanal Chem, 404, 459.
[2]Cequier et al. (2014) Environ Sci Technol, 48, 6827. [3]Vorkamp et al. (2011) Environ. Int., 37, 1-10.

The project is funded by the Danish Council for Independent Research (DFF – 1333-00034)