Determining the contribution of indoor microenvironments to outdoor contamination of halogenated flame retardants

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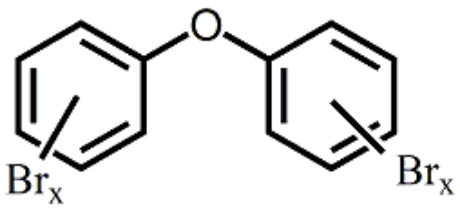
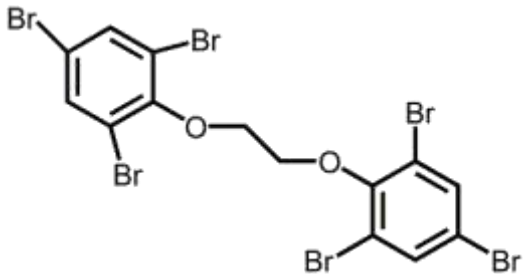
Objectives

- Quantify the contribution of indoor flame retardants (FRs) to outdoor contamination via ventilation systems
- Model the results using fugacity based approaches
- Determine potential for long range transport of new FRs
- Examine chiral signatures for source appointment

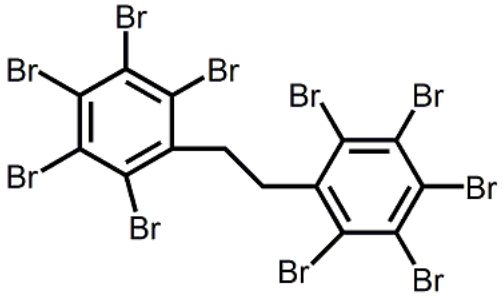
Possible Analytes



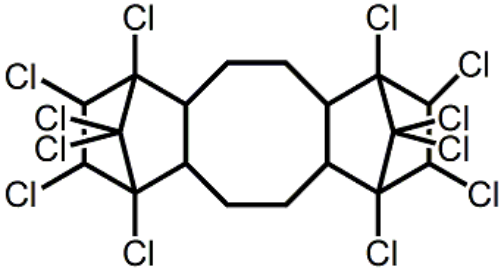
PBDEs



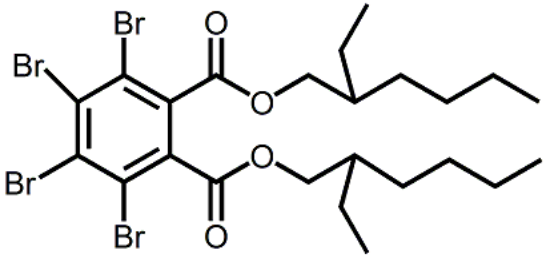
BTBPE



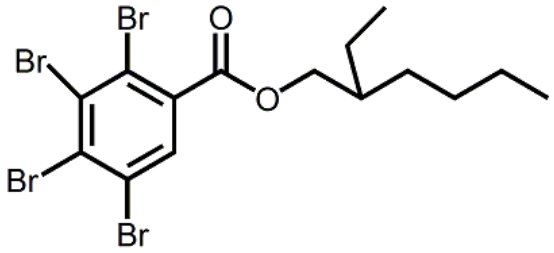
DBDPE



Dechlorane Plus

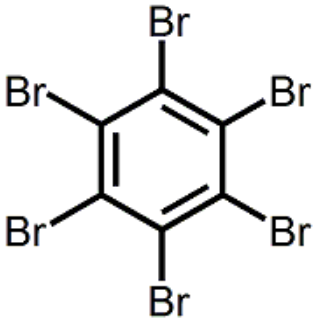


TBPH

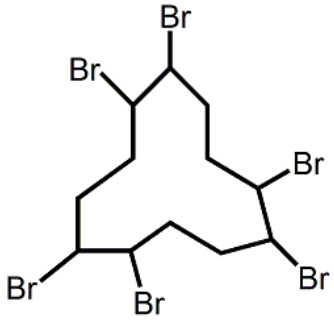


TBB

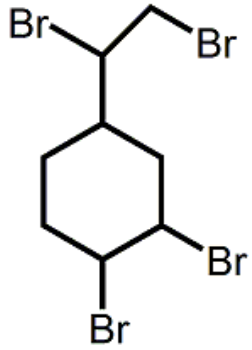
Possible Analytes



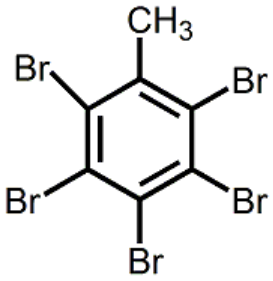
Hexabromobenzene



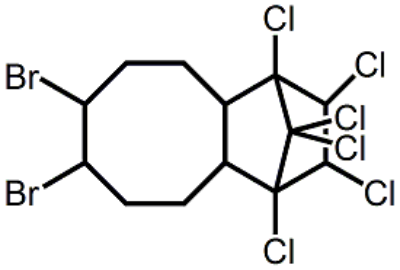
HBCD



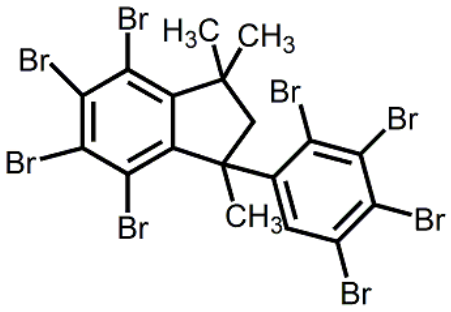
TBECH



Pentabromotoluene

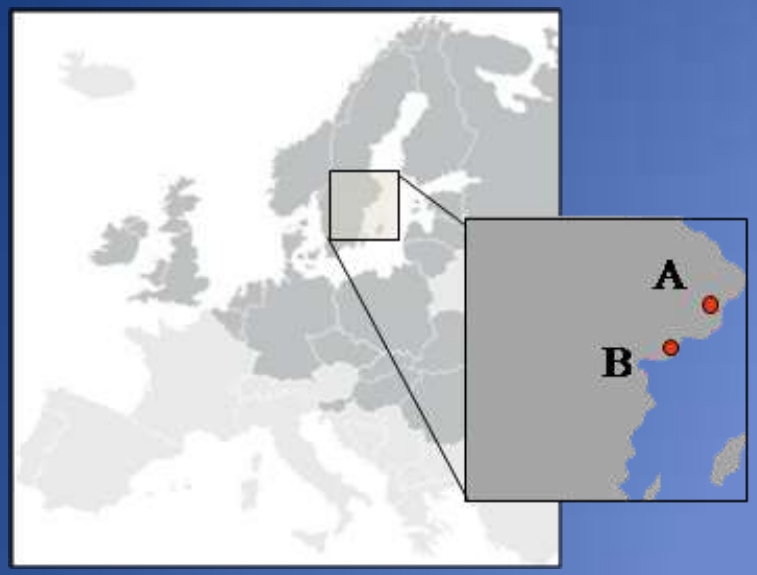


HCDBCO



OBIND

Stockholm Sampling



Sampling Sites: A = Stockholm, B = Rural site

- Air
  - Indoor – various buildings around Stockholm
  - Ventilation systems
  - Outdoor – urban and rural
- Dust – various buildings around Stockholm
- Top Soil – urban and rural

Indoor Air Sampler (low volume)

Outdoor Air Sampler (high volume)

Dust Sampler

Methods

- Analytical methods exist for dust, air, and sediment but need to be refined and validated for new FRs
- GC-MS and LC-MS will both be used
- Chiral analysis (Birmingham)

First Task – Solving Two Problems From a Previous Study

- HBCD was not detected in most air samples in the previous study
  - Too low sampling volumes?
  - Problems with sampling or the analysis method?
- BDE-209 was found in the gas phase when it is thought to be totally particle bound
  - Blow-off from particles during sampling?
  - Bound to particles smaller than filter cut-off?
  - Is it actually in the gas-phase?- Others have reported the same finding!!!

Solutions to Detection Problem

- Sampling for various lengths of time from the same place
- HBCD and new FRs
- Filters can be spiked with C^{13} surrogate standards to evaluate the efficiency of both the PUF adsorbant and the analytical method

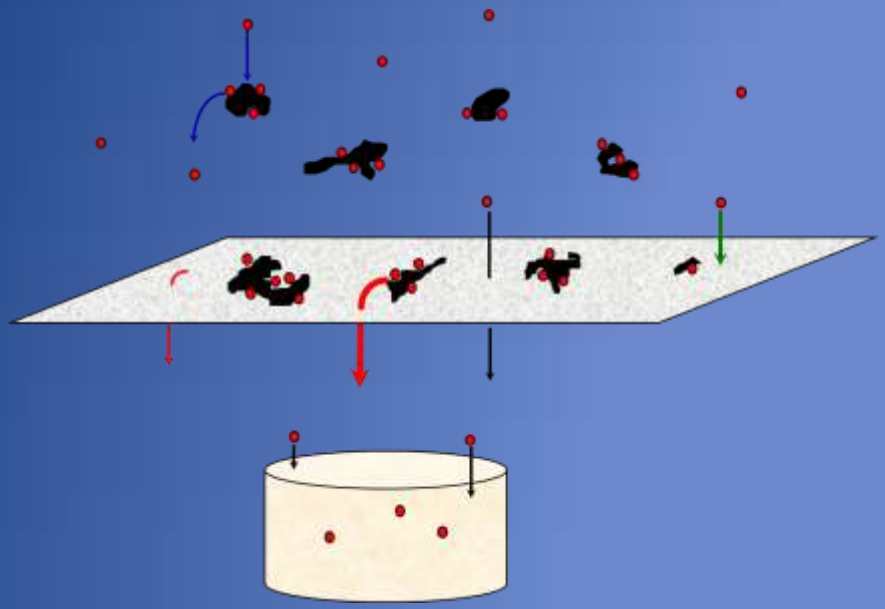
Sampling Two Offices

"Typical" office – one computer

Office with lots of computers

Solution to Partitioning Problem

- Experimentation with different filters?
- Testing the same sampler on outdoor air?
- Using a denuder?



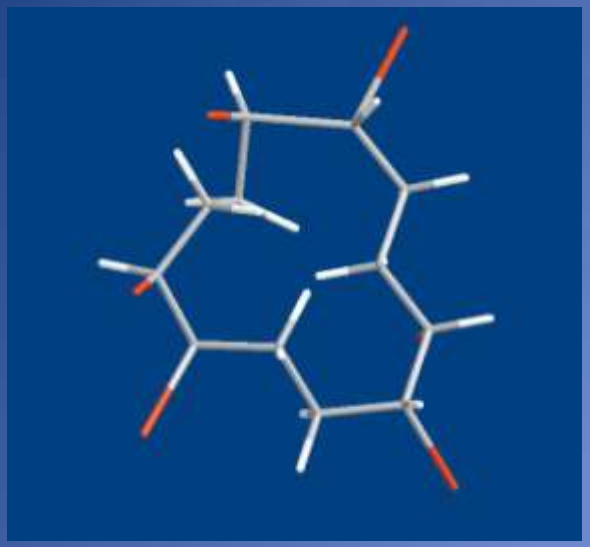
Glass Fiber Filter and PUF sampling system – Particle-bound Analytes can blow off particles and gas phase particles can adsorb on the filter

Chirality Study

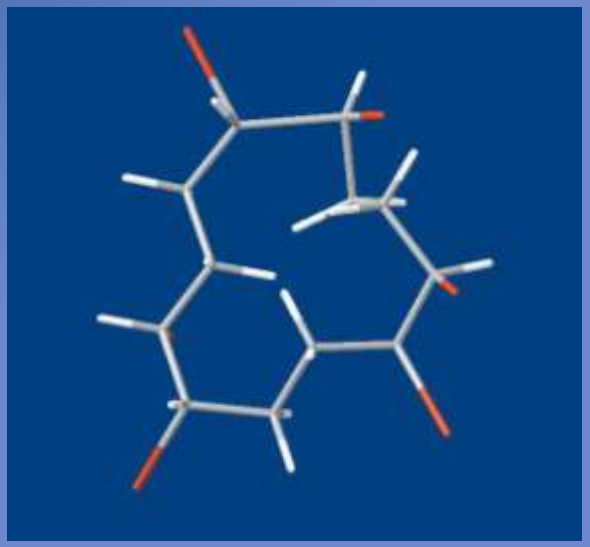
- Some of the FRs are chiral and can undergo enantioselective biodegredation
- Abiotic processes affect enantiomers equally
- Variations in the enantiomeric fractions in environmental compartments can give information about sources of the FR

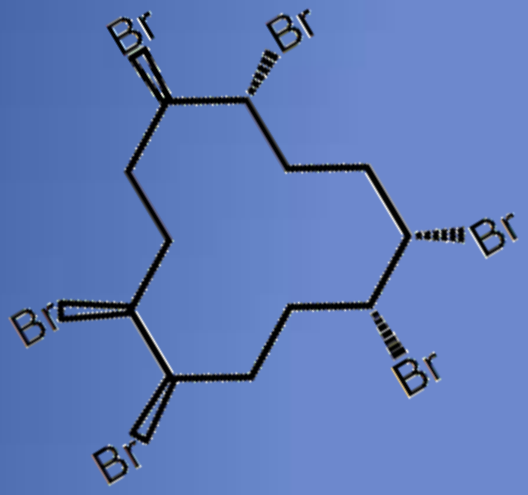
Chirality Study

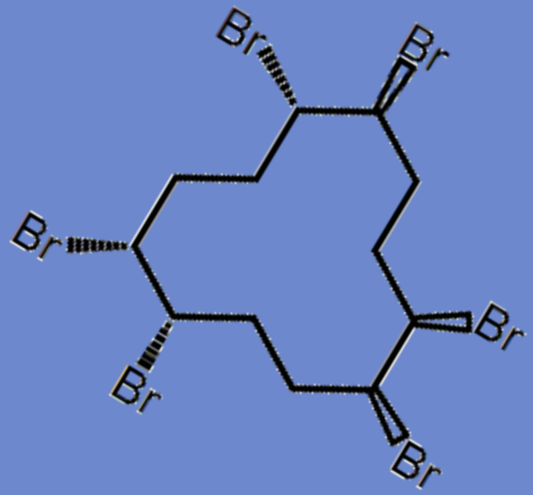
α HCBD (-)



α HCBD (+)







Thanks for Listening!

Questions?