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INFLAME

Using forensic microscopy to elucidate pathways of halogenated flame retardant migration into indoor dust

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ESR2

Background

- **Polybrominated diphenyl ethers (PBDEs)**
  - **polyurethane foams; furniture; circuit boards; thermoplastics (high impact polystyrene - HIPS)**
  - **tetra to hepta banned, alternative FR needed**
- **Hexabromocyclododecane (HBCDs)**
  - **polystyrene foams, furniture, HIPS**

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Background

- **Physically blended rather than chemically blended**
  - **Can be released from treated products, particularly at high operating temperatures**

- **Due to high levels found in the environment[1] interest in migration pathways of these compounds**

[1] Harrad, S. et al. *Environmental Science & Technology*. 2010, *44,* 3221-3231.

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Migration Theories

- Lower MW compounds volatilise from treated products then partition to dust
  - should leave homogenous Br distribution through dust
- Higher MW or less volatile (e.g. PBDE-209) enter dust through abrasion of particles or fibres of treated products
  - should leave heterogeneous Br distribution through dust

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ESEM and EDX

- Environmental Scanning Electron Microscopy (ESEM)
- Energy Dispersive X-ray microanalysis (EDX)
- Sample bombarded high energy photos → release of unique elemental fluorescent X-ray pattern
  - ESEM provides high resolution images of material
  - Allows distribution of Br atoms to be determined

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ESEM and EDX

- EDX used in correlation studies of PBDE dust concentrations with detected Br to mixed results[2,3,4]

- Suzuki et al.[3] and Webster et al.[4] saw heterogeneous distribution in dust with high PBDE-209 levels
  - Microscopy has potential as method for indication of BFR presence

[2] Allen, J.G. et al. *Environmental Science & Technology*. 2008, *42,* 4222-4228.
[3] Suzuki, G. et al. *Environmental Science & Technology*. 2009, *43*, 1437-1442.
[4] Webster, T.F. et al. *Environmental Science & Technology*. 2009, *43,* 3067-3072.

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Micro emission test chambers

- Use previously characterised treated products in specialised, built for purpose, chambers
  - Use EDX to identify products treated with BFRs
- Different configurations to create an abrasion migration pathway and volatilisation/partitioning pathway
- Use ESEM on collected dust to show the distributions of Br

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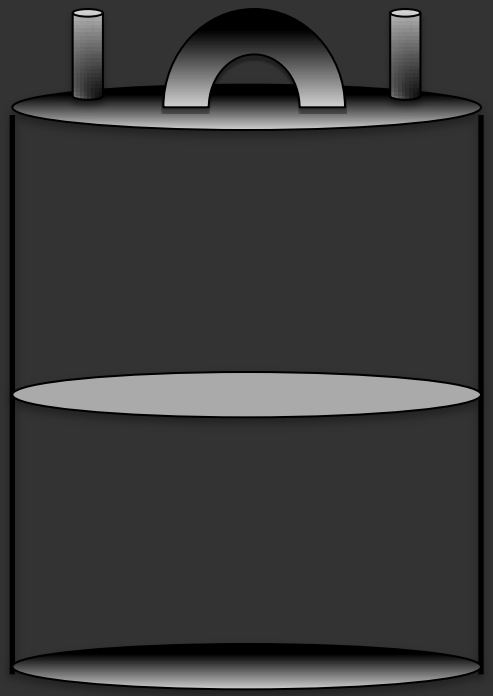
Micro emission test chambers



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Progress to Date

- Familiar with the literature
- Familiar with the clean-up and extraction method
- Optimizing instrumental conditions (LC-MSMS)
  - Validating against SRM 2585 for PBDEs and HBCDs in dust
- Commissioned prototype for micro emission test chamber
- Attended the 2011 Dioxins conference

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Plans for the next 6 months

- **Construction of specially designed micro emission test chambers**
- **Training using EDX**
  - **Identify treated samples for use in test chambers**
- **Training using ESEM**
  - **Analysis of dust samples to identify the Br distribution**

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Thank you for your attention

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