

human exposure and follow the long-term trend of BDE209 bioaccumulation. BDE209 analytical data has been generated for the first 185 serum samples from four European countries. BDE209 analysis consisted of solid phase extraction (ASPEC), followed by an acid silica column clean up. The extracts were analysed by gas chromatography with electron capture negative ionisation and mass spectrometry detection (GC/ENCI-MS) using a short GC column. 13C-BDE209 was used as an internal standard to quantify BDE209 in extracts. Per series a minimum of three blanks and one duplicate analysis were performed. Measured concentrations ranged from <4 (LOD) to 120 pg/g serum or <1 to 49 pg/g serum lipid. BDE209 was undetectable in 18% of the human serum samples overall, with some differences between countries: 38% <LOD (Norway), 20% (Spain), 15% (NL), 5% (UK). Average concentrations in pg/g per country were: 13 (UK), 12 (NL), 8 (Spain) and 7 (Norway). As this and other studies have demonstrated, the detection of BDE209 in human serum is a question of looking for a few picograms of a substance per gram of sample. For BDE209, detection is only possible when efforts are made to achieve very low blank values, which was successfully done with the method used here. Human risk assessment of this chemical can benefit from the quality-controlled, internal BDE209 concentration data produced in this study.

MO 052

Emission load of hexabromocyclododecane in Japan based on the dynamic substance flow analysis

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In this study, we conducted time series substance flow analysis of HBCD to obtain basic information for long term measures toward strategic chemical management. For 2000, HBCD consumption for all application areas was around 2000 tonnes. The stock of HBCD in the use phase was simulated as 15868 tonnes and the total stock in landfills related to this application area is 2170 tonnes. These stocks in anthroposphere will be potentially long-term sources of pollutants leaching or volatilising to the environment. Next, the time series substance flow analysis was conducted from 1986 to 2001, and extrapolated to 2030. HBCD represents a steadily increasing consumption rate. The future consumption reached 3256 tonnes/year in Japan. Emissions of HBCD have been increasing to date in future. The largest component of the emissions is simulated to be into the atmosphere. These emissions are estimated to be as high as 1465 kg/year in 2030. As the stock in the use phase and landfill have been growing over the whole period, the source profile of environmental emission would shift from upstream to downstream of product chain.

MO 053

Determination of polybrominated diphenyl ethers (PBDEs) in soil by gas chromatography-mass spectrometry (GC-MSD) with electron impact (EI) and negative chemical ionization (NCI).

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An analytical method for the determination of 13 PBDE congeners in soil has been developed. Soil samples were extracted by pressurized liquid extraction (PLE) using dichloromethane (DCM). Extracts were then purified by aluminium oxide/silica gel column, PBDE were eluted with 15 ml hexane (hex), 5 ml hexane/DCM (9:1 v/v) and finally 20 ml hex/DCM (4:1 v/v). After evaporating the analytical solution to about 0.5 ml PBDEs were quantified by GC-MSD in the EI-SIM and NCI-SIM mode. The limit of detection (LOD) and the limit of quantification (LOQ) were 36-410 and 85-276 pgg⁻¹ respectively for EI-mode. The LOD and LOQ for the NCI mode were 17-101 and 22-233 pgg⁻¹ respectively. Thus NCI was more sensitive than the EI mode. A spike and recovery study was performed for the entire method using a forest soil from Manaus, Brazil and garden soil from Mainz, Germany. When quantified in the EI-mode recoveries were 55-119% with relative standard deviation (RSD) of 3-11% for Manaus soil and recovery of 72-102% with RSD of 1-18% for Mainz soil. Recoveries for NCI were 88-184% with RSD of 6-29% for Manaus soil and 113-284% with RSD 1-15% for Mainz soil. Matrix enhancement because of the non-specificity of monitored ions (m/z: 79/81) is the probable cause of the higher recoveries in the NCI mode. Matrix enhancement was higher in Mainz soil than Manaus soil. The entire method with GC-NCI-MSD was used to determine PBDE concentration in Manaus and Mainz soil. The PBDE with concentration (pgg⁻¹) higher than their LOQs in Manaus soil were BDE-47: 61, BDE-99: 138, BDE-85: 86, BDE-154: 53 and BDE-153: 328. PBDE with concentration (pgg⁻¹) higher than their LOQ in Mainz soil were BDE-3: 599, BDE-47: 128, BDE-100: 42, BDE-100: 91 and BDE-153: 56.

MO 054

Analysis of PBDD/Fs in human blood samples and a fish sample with high levels of PBDEs

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Brominated dioxins and furans (PBDD/Fs) have been detected in a number of different matrices ranging from fly ash to human adipose tissue and possibly the levels in the environment are increasing. The presence of PBDD/Fs is believed to be linked to the increased usage of brominated compounds such as brominated flame retardants (BFRs). PBDD/Fs can form during thermal and photolytic degradation of BFRs and incineration of these compounds are believed to be a major source. In this study, blood from people with a high consumption of fish from Lake Mjösa, Norway were analyzed for PBDD/Fs. Fish (especially trout) from this lake show high levels of polybrominated diphenylethers (PBDEs) and in a previous study it was shown the consumption of contaminated fish from this site corresponded well with the enhanced serum levels of PBDEs for 66 individuals. The median serum levels of sum 7 PBDEs for 41 males were 5 times higher (18 ng/g lipid) than a control group with no other exposure than the normal background. This might be an indication for high levels of PBDD/Fs in human blood and levels in blood and in trout will be presented to study the relation between levels of PBDD/Fs and PBDEs.

MO 055

Uptake pattern and maternal transfer of polybrominated dioxins and furans in zebra fish (Danio rerio)

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Polybrominated dioxins (PBDD) have recently been found in mussels and fish from the Baltic with high levels in especially mussel. The consistency of the substitution pattern of major PBDDs through the food web suggests a natural origin of these compounds. The findings have raised concern for possible hazardous effects of these compounds on marine life and spurred a series of studies on uptake and biological effects of PBDDs.

In the current study, zebra fish was fed PBDD contaminated feed at NOEL levels (approx. 1ng of each congener per g feed) and the assimilation and possible maternal transfer to roe of different PBDD-congeners (mono- to tetra-substituted) was investigated. Zebra fish was chosen as it is a key test species in several test protocols (OECD, ISO etc.) to evaluate aquatic toxicity. The assimilation of PBDDs was followed for 12 weeks, and the depuration for 6 weeks. Eggs were collected during and after exposure and analyzed for PBDDs to investigate maternal transfer.

Analysis of whole fish except the GI-tract showed that bioaccumulation is strongly dependent on the PBDD substitution pattern. Tri- and tetrabrominated dioxins were found preferably substituted in lateral positions. Lower brominated PBDDs seem to be rapidly metabolized, albeit substantial levels of these compounds are found in biota. This may imply heavy dietary exposure for these compounds, or exposure through a different route, e.g. via the gills. To assess the metabolic influence on the uptake pattern screening for first phase metabolites was performed. Transfer of assimilated compounds to roe was shown for tetrabrominated compounds.

MO 056

Fate-Studies on selected brominated flame retardants in indoor-mesocosm ponds

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In 2008, mesocosm studies were conducted in indoor-ponds of the Artificial Stream and Pond System (FSA) of the Federal Environment Agency in order to investigate the environmental fate of four high production volume brominated flame retardants (BFR), which are still in use namely decabromodiphenyl ether (BDE-209), decabromodiphenyl ethane (DBDPE), bis(2,4,6-tribromophenoxy)ethane (BTBPE) and hexabromocyclododecane (HBCD). The pond mesocosms were equipped with sand, sediment, macrophytes and macro-zoobenthos. Pure compounds were dosed once using a specific spraying device ensuring homogeneous distribution of the BFR in the water. HBCD was dosed separately in one pond equipped with HQI lamps, whereas the remaining 3 BFR were dosed combined in 2 ponds in parallel,