Emerging pollutants: their sampling, determination and risk assessment

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The Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) is a multilateral international treaty adopted under United Nations Environment Programme (UNEP), with intent to "protect human health and the environment from persistent organic pollutants". There are four criteria for compound to be included on the list of SC. Persistence in the environment, bioaccumulation, potential for long range transport and evidence of adverse effects to human health or environment.

Initially treaty identified 12 compounds or compound groups of interest mainly of industrial and agricultural use. List was subsequently expanded so that currently 26 POPs are regulated under SC. Some of the newly added POPs — "emerging pollutants" — represent different group of compounds, which is primarily associated with consumer products and indoor environment and thus present new challenges in their sampling, determination and risk assessment.

Of the newly added emerging pollutants our main interest was in polybrominated diphenyl ethers (PBDEs) and their comparison with legacy compounds, such as polychlorinated biphenyls (PCBs) and pesticides Lindane (HCHs) and DDT with its metabolites. Method for analysis of PBDEs was developed utilizing GC-HRMS with short column (15m) to address their thermal instability. Passive air sampling of PBDEs with polyurethane foam was evaluated both under outdoor and indoor conditions. Guidelines were developed for indoor passive air sampling of PBDEs and other semi-volatile organic compounds (SVOC).

Contamination of indoor environment represents important pathway for human exposure. Knowledge of contamination of indoor matrices and relationships between them is therefore crucial for human risk assessment of SVOC. Study was developed in cooperation with Indiana University in Bloomington and Toronto University to compare indoor contamination of SVOC in Central Europe and North America. Air, dust and window film samples were taken from total of 63 homes and analysed for PBDEs and other flame retardants (NFRs). As was expected from past production and usage, levels of PBDEs were several orders of magnitude higher in US and in Canada than in Czech Republic. Significant relationship was found between concentrations in all three phases for compounds with log K_{OA}<14, suggesting that equilibrium was reached for these compounds.

Air and dust samples were further used for analyses of legacy POPs – PCBs, HCHs and DDT. PCBs congener patterns were consistent with historically produced commercial mixtures. While PCBs concentrations were on similar levels, DDT and HCHs concentrations were significantly higher in Czech Republic. Even though primary sources of PCBs and pesticides are not in indoor environment, their total air concentrations were orders of magnitude higher than levels of PBDEs and NFRs. As concentrations of legacy POPs in the outdoor environment are decreasing, stability of indoor environment may increase its importance for human risk assessment of these compounds.