PASSIVE AIR SAMPLING TECHNIQUE AS A TOOL FOR ESTABLISHMENT OF THE LONG-TERM AIR MONITORING NETWORK AS WELL AS FOR THE ASSESSMENT OF THE OLD BURDENS IMPACT

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Introduction

The potential of passive air sampling (PAS) devices to assess the influence of local pollution sources on the quality of surrounding environment was recently investigated as well as their sensitivity to the seasonal variations in the ambient air concentrations of POPs[1,2]. Polyurethane foam based samplers were employed as described elsewhere[3-6]. The fact that PAS showed a very good capability to reflect temporal and spatial fluctuation in POPs concentrations makes them applicable for monitoring on the local and regional scale. Based on those results, the passive monitoring network was designed in the Czech Republic as the first attempt to use PAS in the long-term country-wide monitoring program. As a part of this project, several point sources were selected for continuous monitoring, including the danger waste disposal sites, and the sites currently being remediated.

Material and Methods

Air sampling

Passive air samplers consisting of the polyurethane foam disks (15 cm diameter, 1.5 cm thick, density 0.030 g cm^{-3}, type N 3038; Gumotex Breclav, Czech Republic) housed in the protective chambers were employed in this study. Sampling chambers were prewashed and solvent-rinsed with acetone prior to installation. All filters were prewashed, cleaned (8 hours extraction in acetone and 8 hours in dichloromethane), wrapped in two layers of aluminum foil, placed into zip-lock polyethylene bags and kept in freezer prior deployment. Exposed filters were wrapped in two layers of aluminum foil, labeled, placed into zip-lock polyethylene bags and transported in cooling box at 5 °C to the laboratory where they were kept in freezer at –18 °C until the analysis. Field blanks were obtained by installing and removing the PUF disks at all sampling sites.

Sample analysis

All samples were extracted with dichloromethane in Büchi System B-811 automatic extractor. One laboratory blank and one reference material were analyzed with each set of ten samples. Surrogate recovery standards (D8-naphthalene, D10-fenantrene, D12-perylene for PAHs analysis, PCB 30 and PCB 185 for PCBs analysis) were spiked on each filter prior to extraction. Terfenyl and PCB 121 were used as internal standards for PAHs and PCBs analyses, respectively. Volume was reduced after extraction under a gentle nitrogen stream at ambient temperature, and fractionation achieved on silica gel column; sulfuric acid modified silica gel column was used for PCB/OCP samples. Samples were analyzed using GC-ECD (HP 5890) supplied with a Quadrex fused silica column 5% Ph for PCBs (PCB 28, PCB 52, PCB 101, PCB 118, PCB 153, PCB 138, PCB 180, and OCPs (α-HCH, β-HCH, γ-HCH, δ-HCH, *p,p´*-DDE, *p,p´*-DDD, *p,p´*-DDT). 16 US EPA polycyclic aromatic hydrocarbons were determined in all samples using GC-MS instrument (HP 6890 - HP 5972) supplied with a J&W Scientific fused silica column DB-5MS.

Results and Discussion

Based on the results of pilot studies, PAS have been first employed as a part of the regular air monitoring program in the Kosetice observatory, Czech Republic (EMEP background station) since 2003. Simultaneous employment of PAS and high volume samplers at this site provided valuable information about the performance of the passive samplers under various meteorological conditions, and demonstrated the seasonal variations (Fig. 1).

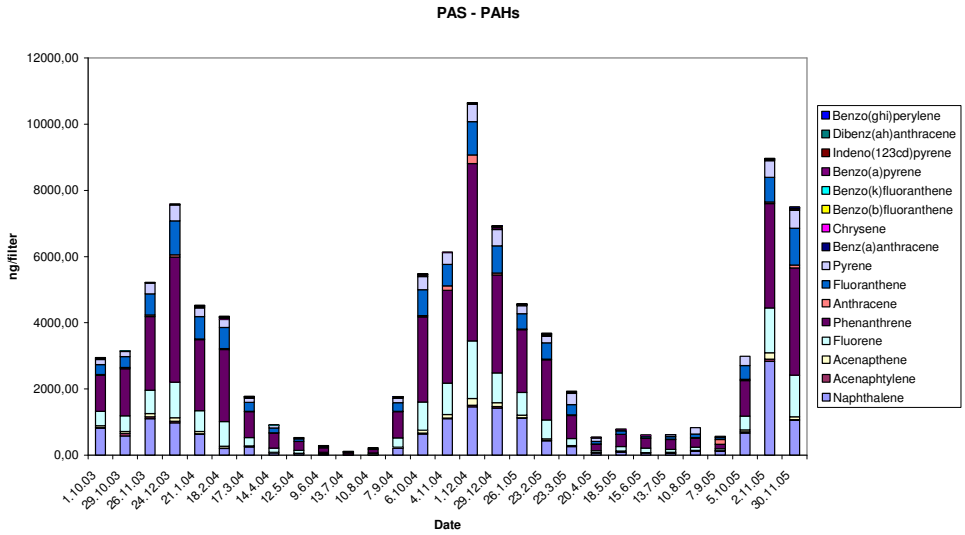

Figure 1: Seasonal variation of PAHs in the ambient air (ng/PAS filter), Kosetice observatory, Czech Republic.

Starting 2004, a long-term PAS monitoring of the various local sources (petrochemical and chemical enterprises, industrial, urban, rural and background sites) in the Czech Republic was established (Fig. 2). PAS network was completed with a number of mountain sites estimating the role of the long-distance transport in 2006.

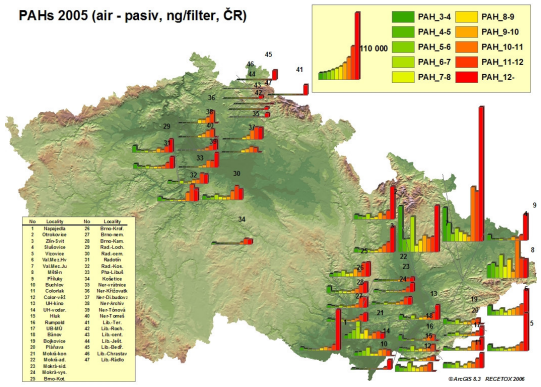

Figure 2: Seasonal variation of PAHs in the ambient air (ng/PAS filter), Czech Republic.

Based on the promising results of the Czech monitoring network, first steps were taken towards extending this project to cover most of the Central and Eastern Europe. Sampling sites in Slovakia, Lithuania, Latvia, Estonia, Romania, Serbia, Bosnia and Herzegovina have been monitored since 2006, with more countries joining the project in 2007.

In addition to the results of the long-term employment of PAS in the Czech and European monitoring programs, a unique study using PAS as a tool for assessment of risks connected with remediation of the old burdens is presented. Spolana Neratovice, a chemical company with the history of production of organochlorinated pesticides, has been a part of various PAS projects of RECETOX since 2004 as a suspected secondary source of OCPs. SPOLANA is one of the leading chemical companies active in the Czech industry; however, between 1952 and 1975 SPOLANA was one of two largest producers of pesticides in former Czechoslovakia. Pesticides

containing DDT were produced between 1958 and 1969, lindane preparations until 1975. Total amount of 60 000 tons of the technical HCH (more than 3 000 tons of pure lindane) was produced causing severe contamination of buildings and the soils. This enterprise has been a subject to intensive decontamination since 2005, and PAS have been used to monitor the impact of the remediation activities both, in and outside the factory grounds. There was a high volume air sampling campaign performed on the site at the beginning of the sanation, a consecutive PAS campaign is serving the goals of monitoring the long-term trends in the ambient air pollution with the special attention to the impact of remediation, and searching for possible old burdens as potential targets. Amounts of HCHs sequestered on the PAS filters exposed on various sites between August and December 2005 are shown in the Fig. 3.

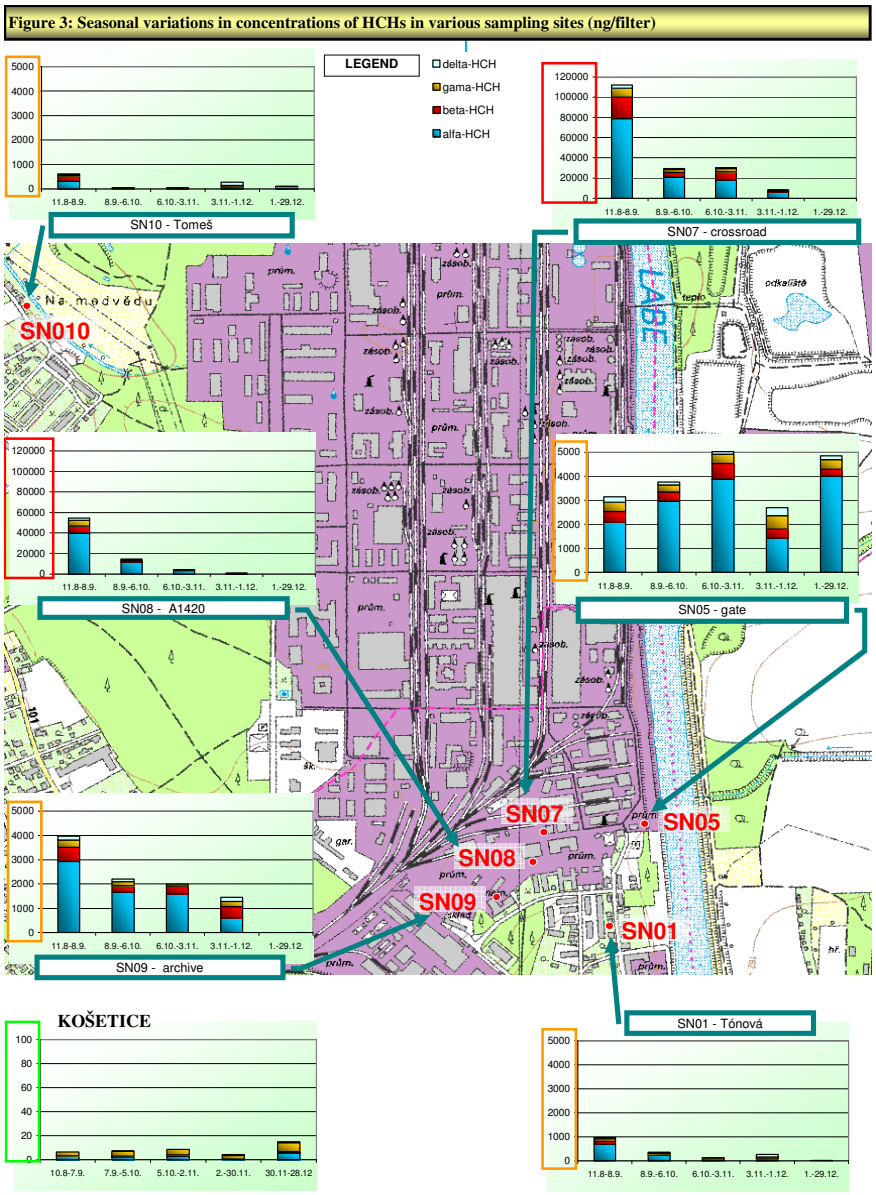

Figure 3: Seasonal variation of HCHs in the ambient air (ng/PUF filter), Spolana Neratovice.

Acknowledgements
The project was supported by the Czech Ministry of Education, Youth and Sport (MSM 0021622412), and by SPOLANA Neratovice. Authors would like to acknowledge the management of SPOLANA, as well as managements of SITA CZ and BCD CZ, companies responsible for remediation site, for the support of this project and help with the sampling campaigns.

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