HOW MUCH DO WE KNOW ABOUT THE POPS IN AFRICA ?? MONET_AFRICA – DEVELOPMENT OF THE AIR MONITORING OF POPS

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Introduction

Long-range transport of persistent organic pollutants (POPs), a broad range of their anthropogenic sources and their evaporation from contaminated soils and water systems represent potential human and environmental risks. These are reasons for many actual international regulations which are focused on the effective regulations of their production, sources and usage around the globe. Important part of this problem is a pressure for development of effective methods for determination and monitoring of these harmful chemicals with the goal to obtain more POPs data for the effectiveness evaluation of the measures of the international conventions. The Stockholm Convention on POPs develops the Global Monitoring Plan and one of the most important recommendations of this plan is to develop and establish the global network to determine the baseline trends at global background sites [1]. When signatory parties are to conduct source inventories, identify ongoing sources, and provide environmental monitoring evidence that ambient levels of POPs are declining [2,3], developing countries in particular require cost-effective and simple approaches [3].

Passive sampling

A few research groups have tested a possibility of application of the passive air samplers (PAS) based on the polyurethane foam (PUF) for the POP monitoring in ambient air on the global, regional and local scales. Results of this intensive research clearly demonstrated that this type of passive samplers is suitable to study the vapour-phase concentrations of POPs [4-6], and to be successfully applied as a tool for POPs monitoring on the global [1] and regional [7] levels. Studies have been conducted to demonstrate a feasibility of employing PAS across the large areas [4,6,8-10]. PAS can be applied for a study of the site- and source-specific fingerprints and they can be also used to conduct screening surveys to help to identify the sources [11,12]. They are often the only way of taking air samples for POP analysis from the remote regions (high mountains, arctic sites) or the countries where no other sampling techniques is available. They can serve as tools for scientific investigations [13] or for evaluation of the model-based predictions of their long range transport potential [14]. As PAS tend to provide information on the long term mean concentrations in the atmosphere and they ignore a variability on the shorter time scale, they are particularly suited to complement the high volume air measurements and serve for the evaluation of the multimedia fate and transport models. After evaluation of the recent results, passive samplers were recommended by the Preliminary Ad-hoc Technical Working Group for the Global Monitoring Plan as a suitable tool for the global monitoring of POPs in ambient air.

On the other hand, due to the sensitivity of PAS to local effects, sampling site selection seems to be crucial for the success of such projects since small-scale variability in each region can exceed the continental variability. To develop a monitoring network, the local conditions must be evaluated very carefully since only detail characterization of potential local effects for every sampling site can assure the successful selection of sites for larger scale monitoring. Performing detailed local screening studies before designing the final network is advisable.

Monitoring application of PUF passive samplers

The Czech Republic was the first signatory country of the Stockholm Convention that offered fully developed and functional tool capable of providing information on the Central European atmospheric levels of POPs as well as the long-term trends in these levels [15] through the integrated monitoring programme in the Kosetice

background station as a part of the European Monitoring and Evaluation Programme (EMEP). This station offers a major advantage of consistent POP data from two decades of high volume monitoring. This dataset with established time trends can itself serve for the evaluation of recent and future trends in the atmospheric concentration of POPs [16]. In addition, passive air samples have been collected in parallel with the high volume samples continuously since 2003. This provides a unique calibration dataset and at the same time, a centre piece of the PAS network in the Czech Republic. Total number of 16 background sites being monitored continuously since 2006 covers the country including the border mountains and allows us to study the spatial variability in the background POP concentration in various stations as well as to avoid the false interpretations derived from one site only [15]. Such data helps to evaluate an impact of various sources and the effectiveness of measures applied to reduce this impact. For this purpose, we succeeded in getting the interest and support of the industrial bodies as well as the local authorities and in consequent establishment of informal consortium, technically and financially supporting further development of the network (MONET_CZ). This is a unique achievement in the global scale [15].

There are other key aspects of the MONET_CZ network. Such well characterized region in the Central Europe with the dense monitoring network provides the core element for the spin-off projects in other countries of the Central, Southern and Eastern Europe. Since many of those countries lack not only data on the POP levels in the atmosphere but also appropriate monitoring and laboratory capacities, this aspect is very valuable. Based on this assumption, MONET_CEEC project was initiated in 2006 with the goal of building the monitoring capacity in this region. Network of partner institutions was established and they cooperated in designing the pilot screening study in the CEE region in 2006-2008 [16]. Transfer of know-how, educational and training activities are an important part of the MONET_CEEC project.

Not only Eastern European, but also many countries from the African, Asian and South American continents suffer the lack of data on concentrations of persistent organic pollutants in the environmental matrices. This is even more alarming in the countries recently affected by the wars or military conflicts, where the chemicals released to the environment during the military operations and following fires can cause a significant environmental impact and potential negative health effects on the population. The passive air samplers proved to be a powerful sampling technique capable of detecting the concentrations ranging over four orders of magnitude providing the information very comparable with the conventional techniques [17].

POPs in Africa

The history of the POP (especially pesticides) application in the African countries dates back to the 1940s'. It was used mostly in the agricultural production of food crops such as maize, sorghum and millet, and cash crops for export such as cocoa, rubber, cotton and timber; for the disease vector control – especially malaria and tsetse fly. Generally, there is a paucity of data on the production, import, storage, and use of POPs in all countries from this region.

POPs pesticides are not presently produced in Africa, but an existence of some hot spots with obsolete pesticides including POP pesticides is well known. Information on the quantities of POPs imported into the continent is not available, but a survey on pesticides usage is currently on progress as a part development of the national POPs inventories. National implementation plans for the implementation of the Stockholm Convention on POPs in the individual countries should be based on such inventories. One of the recent surveys, for instance, showed that POP pesticides are still sold in the markets, even though major chemicals importers claimed to have stopped such import several years ago.

Monitoring of POPs in Africa

Presently, there are no consistent monitoring programmes focused on the POP levels in air, human tissues and other environmental matrices. The first measurement of the POPs levels in ambient air was performed as a part of the Global Atmospheric Passive Sampling (GAPS) study. This project has been funded by Canadian government and it demonstrates the feasibility of using passive samplers to assess the spatial distribution of persistent organic pollutants on a worldwide basis. The GAPS network includes more than 40 sites on 7 continents?, mainly in background locations, with some representation of urban and agricultural areas. The levels

of organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDEs) derived from the samplers, deployed from December 2004 to March 2005, were published recently [18].

Only 3 sampling sites from this project have been located in Africa and the POP levels found at these sites were not significantly different from the background sites in other continents. Just in the case of HCHs, the elevated concentrations were observed in De Aar, South Africa (117 pg m^{-3}). This level was similar to other sites from the GAPS network, like Harbin and Chengdu, China (132 and 145, respectively) and Georgia (102). The higher concentrations in DeAar are, similar to China, likely associated with a past use of technical HCH in these regions.

MONET_Africa

Due to this lack of information, the whole African continent has been included into the MONET passive air sampling network. The project "Determination of trends in the ambient air POPs concentrations in the Central and Eastern European Region and Africa using the polyurethane foam based passive air samplers" has been supported by Swedish government and RECETOX Centre of the Masaryk University with the goal of filling the informational gap about the POP levels in ambient air in the countries of Africa, Central Asia and Central and Eastern Europe.

For Africa, this project represents the first POP screening study organized in a close cooperation with the local institution. As in the case of Europe, the educational and capacity building activities are an important part of this study. While the samples from the six-months screening campaigns are currently being analyzed in the RECETOX laboratories, local personnel are trained at the same time. Steps have been taken towards an enhancement of the laboratory capacities, both instrumental and personal. The results of the pilot screening study should serve as a base for the establishment of the long-term PAS monitoring programme in this region operated by the local institutions.

This approach requires not only dissemination of knowledge on newly developed sampling techniques but also on methods of chemical analysis, toxicological screening, and risk assessment. Activities in the field of co-operation and education, workshops and practical trainings has been established in the last three years under the umbrella of the Research Centre for Environmental Chemistry and Ecotoxicology RECETOX, EU DG Research Centre of Excellence, and they are supported and promoted by newly established Central and Eastern European POPs Centre.

The pilot phase of the African PAS monitoring has been initiated in January, 2008 and will be completed in July, 2008. Morocco, Tunis, Egypt, Senegal, Nigeria, Mali, Togo, Ghana, Sudan, Ethiopia, Congo, Democratic Republic of Congo, Zambia, Kenya, Tanzania, South Africa, Mauritius are among the participating countries (see Figure). Each country has at least one monitoring site with three parallel passive samplers. Six 4-week air samples are being collected for the analyses of polychlorinated biphenyls, organochlorine pesticides (DDTs, HCHs, hexachlorobenzene) and polyaromatic hydrocarbons. Additional two samples are collecting 12-week air samples for the analyses of polychlorinated dibenzo-*p*-dioxins, dibenzofurans, and pesticides. In most of the countries, additional air samples are also collected for parallel POP analyses in the local laboratories and intercalibration of participating institutions. Three countries are representing by five sampling sites in an attempt to establish a contamination gradient between the polluted regions and background sites.

Conclusions

This study offers an important contribution to our current knowledge on the levels and distribution of POPs in the African continent where no sufficient monitoring programmes are available. In so doing, it not only assists a successful realisation of the Global Monitoring Plan of the Stockholm Convention, but it also supports the local institutions in their effort for the enhancement of the POP monitoring capacities.

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Figure : MONET-AFRICA – Sampling sites - pilot phase 2008