Cod: 8.5006

PASSIVE SAMPLING FOR PCB MONITORING

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Introduction

Persistent organic pollutants (POPs) are chemicals that persist in the environment, bioaccumulate through the food web, and exhibit toxic effects that may threaten the health of humans and wildlife.[1)] Active air sampler (AAS) is useful in the monitoring of POPs in air. Air sample was collected for POPs analysis using a filter/adsorbent. AAS using conventional air samplers requires pumps, filter/adsorbent, and source of electricity. This type of sampling can be costly and not always feasible, especially if several simultaneous sampling are required at different locations. There is an incentive therefore to further develop passive air sampler (PAS). [2)] The mechanism of uptake in PAS is based on the molecular diffusion from air to passive sampling medium. PAS are capable of time-integrated sampling with relatively low cost and simple operation, which is independent from power supply and free of noise. [3)] Therefore PAS is expected as a simultaneous monitoring in numerous locations. Various researchers investigate basic research.[4,5)]

We reported sampling rate of PCB congeners in same location at the same period using PAS and AAS in previous study[6)].

Materials and methods

Passive air sampling:

Polyurethane foam plug (PUF: 85mm diameter , 50mm high) was set by different size double stainless steel bowl to protect the passive air sampler from direct deposition of particulate matter and to minimize the influence of varying air velocity. PAS was deployed 1 month period in the sampling location. PCB was extracted using Soxhlet by acetone from PUF. Acetone solution concentrated and transferred to hexane.

Sampling location for passive sampling:

The air samples were collected near the river with four locations in the territory of Belgrade: confluence the river is in Čukarički Rukavac (CR), Marina Dorćol (MD), Zemunski Kej (ZK) and the mouth of the river Sava and the Danube, Usce (U). Fig.1 shows sampling locations in the territory of Belgrade. Air were sampled near the river of sediment sampling locations. Sediments were sampled from four depths in undisturbed condition as follows: 0-1, 1-3, 3-6 and 6-10 cm. The highest level of PCB in a sample was determined by CR sediment (169-305 ng/g) and MD (19.3-54.5 ng/g), while the sample concentration in ZK (6.2-7.1 ng/g) and U (2.1-5.3 ng/g) were relatively low.

Active air sampling:

AAS was run alongside PAS using a low volume pump with two PS-Air Cartridge (Waters). AAS was deployed during same period of PAS. PCB was eluted using hexane from PS-Air cartridge. Hexane solution concentrated and substituted to 2,2,4-trimethylpentane.

Comparison of adsorbent for passive sampling:

Various adsorbents were used for passive sampling, and were compared for congener profile. MonoTrap RSC18, RGC18 (GL Sciences) as Silica monolith adsorbent and VOC-TD (Sigma Aldrich) were used as well as Polyurethane foam plug for simultaneous sampling as adsorbent for passive sampler (Fig.2,3).

Sample extraction and analysis:

PCB was analyzed using GC-MS/MS (Bruker, 320MS). HT8-PCB capillary column (Kanto Kagaku) was used for PCB congeners-specific analysis. EC5433 (CIL) was used for PCB determination as standard, and before deployment ^{13}C-labeled PCB congeners (MBP-CG) was spiked for internal standard.

Results and discussion:
MRM chromatograms of PCB in air collected using PAS (PUF: adsorbed PCB) and AAS (PS-Air: adsorbed PCB) chromatograms were showed previously[6]. Sampling rate of PCB congeners (m^3/day) were calculated using the value PAS(ng) and AAS(ng/m^3) . Average of sampling rate[6] of PCB congeners were TrCBs 0.4(#19) to 1.1 m^3/day(#31), TeCBs 0.6(#45) to 1.3 m^3/day(#70), PeCBs 0.6(#85) to 1.8 m^3/day(#118), HxCBs 0.7(#151) to 1.4 m^3/day(#138). Calculated sampling rate is same level with the other reports.

Level of POPs in ambient air
We evaluate POPs level in ambient air around Belgrade, Serbia. Total HCHs, total DDTs, total Chlordanes and HCB were estimated POPs level using sampling rate value as 3m^3/day. (Fig.4)

Homologue distribution of PCB
We previously reported that PCB homologue distribution in air reflects product use distribution. Homologue distribution of PCB in air were measured by AAS and PAS. Homologue distribution characterizes the sampling site, and is in good agreement with each other, AAS and PAS method.

Congener profiles
Data for isomer distributions of TrCB, TeCB, PeCB, HxCB from various sources is needed to be accumulated in order to evaluate model and to estimate the origin from the homologue distributions and isomer distributions observed.

Acknowledgements:
This work was supported by JSPS KAKENHI Grant Number 25513003.

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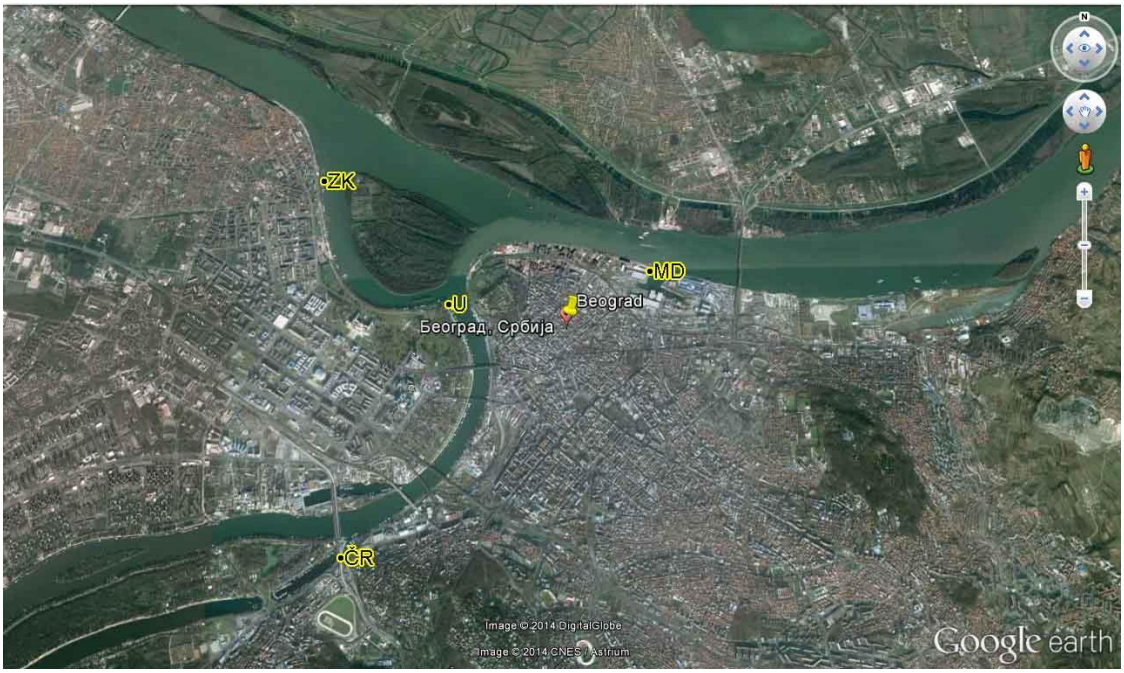

Fig. 1 Sampling location in Belgrade

Fig. 2 Silica monolith adsorbent MonoTrap RSC18, RGC18 (GL Science)

Fig. 3 VOC-TD (Sigma Aldrich)

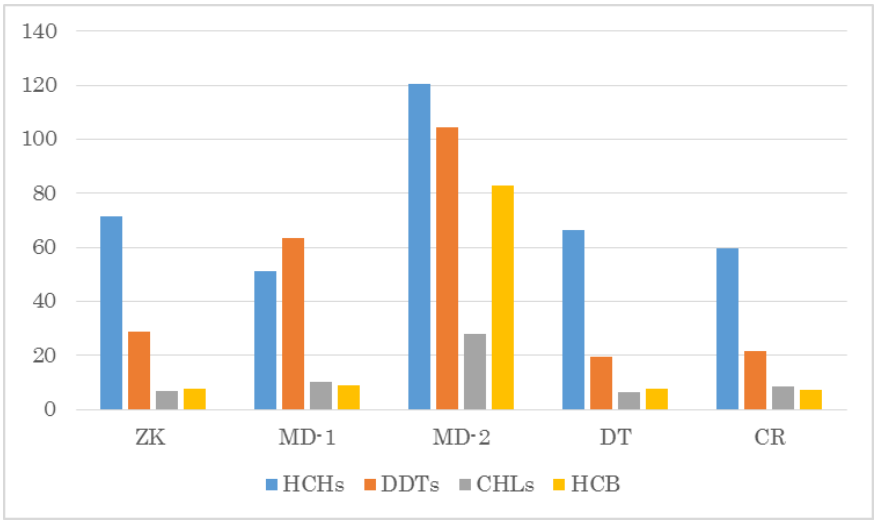

Fig.4 Evaluation of POPs level in air using passive sampling (pg/m^3)

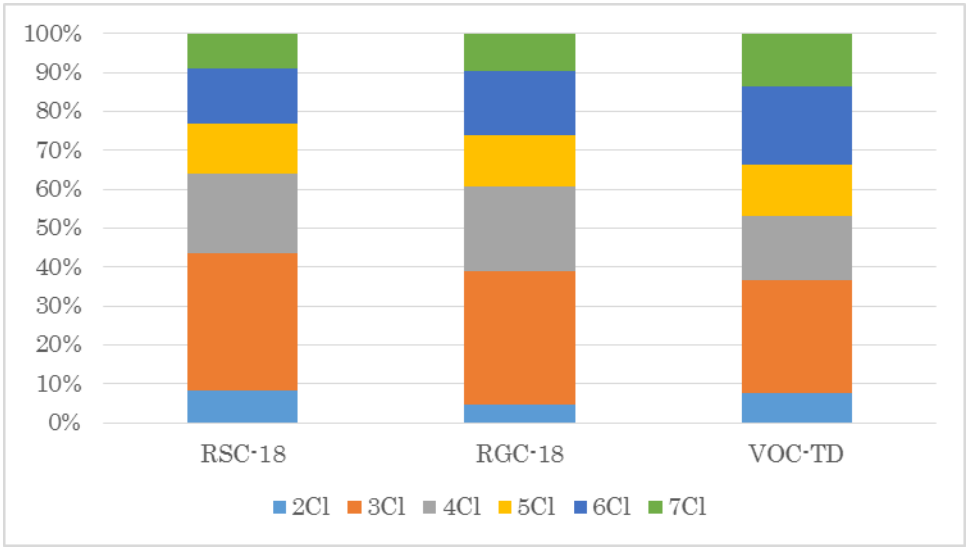

Fig.5 PCB homologue profile in air using different adsorbent

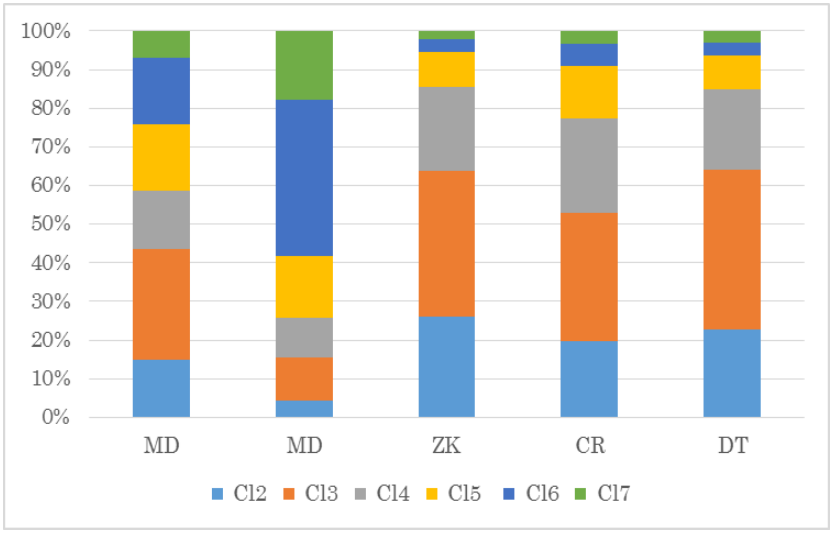

Fig.6 PCB homologue profile in air using passive sampler
(MD, ZK, CR, DT: downtown of Belgrade)