



An interlaboratory study on passive sampling of emerging water pollutants



Branislav Vrana^{a,b,*}, Foppe Smedes^{a,c}, Roman Prokeš^a, Robert Loos^d, Nicolas Mazzella^e, Cecile Miege^f, H el ene Budzinski^g, Etienne Vermeirssen^{h,i}, Tom aš Ocelka^{j,k}, Anthony Gravell^l, Sarit Kaserzon^m

^a Faculty of Science, Research Centre for Toxic Compounds in the Environment (RECETOX), Masaryk University, Kamenice 753/5, Brno 625 00, Czech Republic

^b Water Research Institute, Nabr. Arm. Gen. L. Svobodu 5, Bratislava 812 49, Slovakia

^c Deltares, P.O. Box 85467, Utrecht 3508 AL, The Netherlands

^d European Commission – DG Joint Research Centre (JRC), Institute for Environment and Sustainability (IES), Via Enrico Fermi 2749, TP 290, Ispra, VA 21027, Italy

^e IRSTEA, 3 bis quai Chauveau, CP 220, Lyon 69336, France

^f IRSTEA, 50 avenue de Verdun, Cestas 33612, France

^g EPOC-LPTC, UMR 5255 CNRS, Universit e de Bordeaux 1, 351 crs de la Liberation, Talence 33405, France

^h Swiss Centre for Applied Ecotoxicology Eawag-EPFL, 8600 D ubendorf, Switzerland

ⁱ Eawag, Swiss Federal Institute of Aquatic Science and Technology, 8600 D ubendorf, Switzerland

^j Institute of Public Health, Partyzanske nam. 7, Ostrava 702 00, Czech Republic

^k Environmental & Health Services,  itn a 1633/47, Prague 120 00, Czech Republic

^l Natural Resources Wales– Llanelli Laboratory, 19 Penyfai Lane, Llanelli SA15 4EL, UK

^m The National Research Centre for Environmental Toxicology (Entox), The University of Queensland, 39 Kessels Rd., Coopers Plains, QLD 4108, Australia

ARTICLE INFO

Keywords:

Brominated diphenyl ether
Fluorinated surfactant
Emerging pollutant
Interlaboratory study
Pharmaceutical
Polar pesticide
Passive sampling
Steroid hormone
Water analysis

ABSTRACT

An inter-laboratory study was organised for the monitoring of emerging aquatic pollutants (pharmaceuticals, pesticides, steroids, brominated diphenyl ethers and others) using passive samplers. Thirty laboratories participated in the sampler comparison exercise. Various samplers designs were exposed at a single sampling site to treated waste water. The organisers deployed in parallel multiple samplers of a single type, which were distributed for evaluation of the contribution of the different analytical procedures to the data variability. Between laboratory variation of results from passive samplers was about factor 5 larger than within laboratory variability. Similar results obtained for different passive samplers analysed by individual laboratories and also low within laboratory variability indicate that the passive sampling process is causing less variability than the analysis. Concentrations in composite water samples were within the range obtained by passive samplers. In future a significant improvement of analytical precision and calibration of adsorption based passive samplers is needed.

  2015 Elsevier B.V. All rights reserved.

Contents

1. Introduction	154
2. Material and methods	155
2.1. Design of the study	155
2.2. Target compounds	155
2.3. Standard solution	155
2.4. Participant passive sampler	155
2.5. Provided passive sampler	156
2.5.1. Sampler for polar compounds	156
2.5.2. Sampler for BDEs	156
2.6. Composite water sample	156

* Corresponding author. Tel.: +420 549 494 975; Fax: +420 549 49 2840.

E-mail address: vrana@recetox.muni.cz (B. Vrana).

2.7.	Participants	156
2.8.	Sampling site	156
2.9.	Data evaluation	157
2.9.1.	Box-and-whisker plots	157
2.9.2.	Bar graphs	157
2.9.3.	Biplot graphs	160
2.9.4.	Expression of data variability	160
2.9.5.	Contribution of the calculation procedure to data variability	160
3.	Results and discussion	162
4.	Conclusions	163
4.1.	Accuracy of analysis of complex samples using LC/MS methods	163
4.2.	Availability of accurate calibration data for adsorption based PS	163
4.3.	Experience with state-of-the art approaches to evaluate data from partition-based PS of hydrophobic compounds	163
4.4.	Organisation of future inter-laboratory studies	164
	Acknowledgments	164
	Appendix: Supplementary material	164
	References	164

1. Introduction

Passive samplers can play a valuable role in monitoring water quality within a legislative framework such as the European Union's Water Framework Directive (WFD). Chemical water analysis is done on routine basis in the Member States according to their national regulations and it is crucial that currently applied approaches will merge into a common strategy which results in comparable assessments throughout Europe. The recently issued Directive 2013/39/EU on Environmental Quality Standards under WFD [1] specifically recommends further development of passive sampling techniques as a promising tool for future application (e.g. in compliance checking and trend monitoring of priority substances). The potential of passive samplers (PS) to support WFD monitoring requirements was first recognized in an ad hoc expert meeting organised by the NORMAN association in 2009 [2]. Other initiatives to investigate the application of PS in regulatory monitoring were the "Utrecht workshop" organized by Deltares [3], the SETAC Pellston workshop on PS methods in sediments, [4] and the ICES Workshop on Passive Sampling and Passive Dosing [5]. One of the outcomes of these workshops was that interlaboratory trials are essential to further validate this sampling method and to increase the confidence of the technological approach for end users. A number of interlaboratory studies addressing PS in the aquatic environment have been conducted so far, targeting mainly PS of hydrophobic persistent organic pollutants (Table 1). Allan et al. [6] showed that free dissolved water concentration values of nonpolar compounds obtained from LDPE strip samplers, SPMDs and silicone PSs deviated

less than a factor of 2 from the average of six PSs. Similar results were reported by Miège et al. [7], who evaluated the measurement of selected polar pesticides, polycyclic aromatic hydrocarbons (PAHs) and metals by various available passive sampling techniques in freshwater and marine environments. Although the above mentioned studies assessed the current variability of the passive sampling method, the chosen study designs in most cases did not allow to assess the contribution of various steps of the passive sampling process (i.e. sampling, sample analysis and calculation of the water concentrations) to the observed variability. The ICES Passive Sampling Trial Survey identified chemical analysis (20–40%) and sampling rate estimation (30%) to be the main sources of interlaboratory variability of reported water concentration values of PAHs and polychlorinated biphenyls (PCBs) [8–10]. Most recently, QUASIMEME [11] organised a proficiency testing (PT) scheme on silicone rubber (SR) analysis (for PAHs, PCBs and brominated diphenyl ethers; BDEs) and on conversion of concentrations in SR into water concentrations. The PT scheme revealed that most of the participating laboratories were able to analyse PAHs, PCBs and PBDEs in SR with a satisfactory z-score (<2). Most laboratories also showed a good performance in application of existing models [12,13] available for translation of passive sampling data into water concentrations.

The inter-laboratory study presented here was organised in 2011 by the NORMAN association (Network of reference laboratories for monitoring emerging environmental pollutants; www.norman-network.net) together with the European DG Joint Research Centre as a follow-up of the above mentioned exercise [7]. It was a learning exercise with the objective to assess the current variability of

Table 1
Inter-laboratory studies addressing passive sampling of organic pollutants in aquatic environment

Inter-laboratory study	Study design	Sampler/s	Sampled matrix	Analytes	Reference
ICES Trial Survey and intercalibration on Passive Sampling	<i>In situ</i> laboratory inter-comparison exercise	Silicone rubber (SR) sheets	seawater and sediment	PAHs and PCBs	[8–10]
SWIFT-WFD studies	<i>In situ</i> sampler inter-comparison exercise	Chemcatcher, low density polyethylene membrane (LDPE), membrane-enclosed sorptive coating (MESCO), silicone rods, silicone strips and semipermeable membrane devices (SPMD)	river water and fortified river water	PAHs, PCBs, hexachlorobenzene, p,p'-DDE	[6,30]
ECLIPSE study	Laboratory sampler inter-comparison exercise	SPMD, SR, LDPE, Chemcatcher, CFIS sampler	fortified tap water	PCBs	[31]
AQUAREF study	<i>In situ</i> sampler inter-comparison exercise	Various passive samplers	river water and seawater	PAHs, currently used pesticides	[7]
QUASIMEME Passive Sampling Development Exercise	Proficiency testing scheme on sampler analysis and conversion of concentrations in sampler into water concentrations	Silicone rubber sheets	seawater	PAHs, PCBs, PBDEs	[11]

Download English Version:

<https://daneshyari.com/en/article/7689166>

Download Persian Version:

<https://daneshyari.com/article/7689166>

[Daneshyari.com](https://daneshyari.com)