Talanta 148 (2016) 556–571

Contents lists available at ScienceDirect

Talanta

journal homepage: www.elsevier.com/locate/talanta

Overview of the Chemcatcher® for the passive sampling of various pollutants in aquatic environments Part A: Principles, calibration, preparation and analysis of the sampler

Adeline Charriau [a,*], Sophie Lissalde [a,*], Gaëlle Poulier [a,b], Nicolas Mazzella [b], Rémy Buzier [a], Gilles Guibaud [a]

[a] Groupement de Recherche Eau Sol Environnement (GRESE), Faculté des Sciences et Techniques – Université de Limoges, 123 Avenue Albert Thomas, 87060 Limoges Cedex, France
[b] Unité de recherche EABX, Groupement Irstea de Bordeaux, 50 Avenue de Verdun, Gazinet, 33612 Cestas Cedex, France

ARTICLE INFO

Article history:
Received 18 February 2015
Received in revised form
17 June 2015
Accepted 21 June 2015
Available online 13 July 2015

Keywords:
Freshwater
Micropollutants
Environmental monitoring
Passive sampling
Chemcatcher®
Calibration

ABSTRACT

The passive sampler Chemcatcher®, which was developed in 2000, can be adapted for various types of water contaminants (*e.g.*, trace metals, polycyclic aromatic hydrocarbons, pesticides and pharmaceutical residues) depending on the materials chosen for the receiving phase and the membrane. The Chemcatcher® has been used in numerous research articles in both laboratory experiments and field exposures, and here we review the state-of-the-art in applying this passive sampler. Part A of this review covers (1) the theory upon which the sampler is based (*i.e.*, brief theory, calculation of water concentration, Performance and Reference Compounds), (2) the preparation of the device (*i.e.*, sampler design, choice of the membrane and disk, mounting of the tool), and (3) calibration procedures (*i.e.*, design of the calibration tank, tested parameters, sampling rates).

© 2015 Elsevier B.V. All rights reserved.

Contents

1. Introduction . . . 557
2. Theory and calibration . . . 558
 2.1. Calculation of water concentration (C_w) . . . 558
  2.1.1. The Chemical Reaction Kinetic (CRK) model . . . 558
  2.1.2. The Mass Transfer Coefficient (MTC) model . . . 558
 2.2. Sampler calibration . . . 558
 2.3. Use of a performance and reference compound . . . 561
3. Sampler configuration and selectivity . . . 561
 3.1. Chemcatcher® body . . . 561
 3.2. Available materials for the receiving phase and membrane . . . 562
 3.3. Disks and membranes: assorted mountings according to the targeted pollutants . . . 562
 3.4. Considerations with the use of a covered or uncovered Chemcatcher® configuration . . . 562

Abbreviations: AMPA, AminoMethylPhosphonic Acid; CA, Cellulose Acetate; DGT, Diffusive Gradient in Thin films; GC, Gas Chromatography; HPLC, High Performance Liquid Chromatography; ICP-MS, Inductively Coupled Plasma Mass Spectrometry; LA-ICP-MS, Laser Ablation Inductively Coupled Plasma Mass Spectrometry; LDPE, Low Density PolyEthylene; MESCO, Membrane-Enclosed Sorptive Coating; MS, Mass Spectrometry; PAH, Polycyclic Aromatic Hydrocarbons; PBDE, PolyBromoDiphenylEthers; PC, Poly Carbonate; PCB, PolyChloroBiphenyls; PDB, Polyethylene Diffusion Bag; PE, PolyEthylene; PES, PolyEtherSulfone; POCIS, Polar Organic Chemical Integrative Sampler; POM, PolyOxyMethylene; PRC, Performance Reference Compound; PS, PolySulfone; PTFE, PolyTetraFluoroEthylene; PVC, PolyVinynilChloride; PVDF, PolyVinyliDeneFluoride; R_s, Sampling Rate; SDB-RPS, polyStyreneDivinylBenzene-Reverse Phase Sulfonated; SDB-XC, polyStyreneDivinylBenzene-exchange; ToF, Time of Flight; SPMD, Semi-Permeable Membrane Device; TWAC, Time Weighted Average Concentration; UPW, Ultra-Pure Water

* Corresponding authors.
E-mail addresses: adeline.charriau@unilim.fr (A. Charriau), sophie.lissalde@unilim.fr (S. Lissalde).

http://dx.doi.org/10.1016/j.talanta.2015.06.064
0039-9140/© 2015 Elsevier B.V. All rights reserved.

3.5. Improvement of hydrophobic compound sampling by addition of *n*-octanol . . . 567
4. Practical aspects in the processing of Chemcatcher® devices . . . 567
4.1. Preparation and conditioning of the sampler . . . 567
4.1.1. Inorganics . . . 567
4.1.2. Organotin compounds . . . 567
4.1.3. Organics – PAH–PCB . . . 567
4.1.4. Organics – pesticides and pharmaceuticals . . . 567
4.2. Elution and extract analysis . . . 567
4.2.1. Inorganic and organotin compounds . . . 567
4.2.2. Organics – PAH–PCB . . . 568
4.2.3. Organics – pesticides and pharmaceuticals . . . 568
5. Comparison with other passive samplers . . . 568
6. Conclusion . . . 569
Appendix A. Supplementary material . . . 570
References . . . 570

1. Introduction

Water quality monitoring needs more efficient techniques in order to evaluate environmental pollution from various types of contaminants. Analytical progress has been made in the sensitive determination of both organic and inorganic trace contaminants in environmental matrices, but one of the major limiting factors remains the sampling step. Indeed, spot sampling is the cheapest and most commonly encountered sampling methodology but there are some limitations, in particular regarding its representativeness [1,2]. Moreover, short-term pollution events (*e.g.*: run off events or accidental pollution) may be missed and large volumes of water are required for the study of trace level contaminated sites.

Both inorganic and organic groups of contaminants can be sampled by passive sampling. Inorganic pollutants can be sampled by DGT (Diffusive Gradient in Thin film) or Chemcatcher® [3]. For organic pollutants, several passive sampler designs have been developed: POCIS (Polar Organic Chemical Integrative Sampler), SPMD (Semi-Permeable Membrane Device), MESCO (Membrane-Enclosed SorptiveCOating), Chemcatcher® and others [3–6].

Briefly, contaminants accumulate in a receiving phase, by diffusion followed by sorption, with an integrative step before equilibrium is reached. Passive samplers can be used during the integrative accumulation phase or at equilibrium [7]. POCIS, DGT, Chemcatcher® and SPMD are for instance commonly applied in the integrative accumulation phase in order to calculate time weighted average concentrations (TWACs) of pollutants [7,8]. Passive Diffusion Bag Samplers (PDBSs), polyoxymethylene (POM) [9–11] and also POCIS or Chemcatcher®, with longer deployment periods, can be used at equilibrium.

This review focuses on the passive sampler Chemcatcher®, which has the particularity of being adapted to organic, organometallic and inorganic contaminants depending on the receiving phase and membrane. The first application of this sampler was reported by Kingston et al. [3] for organic contaminants (Fig 1). One year later, the first application for inorganic contaminants with a chelating disk was developed by Bjorklund Persson et al. [12]. Two patents were published; the first in 2004 in the United Kingdom by Kingston et al. [13] and the second in 2006 in the United States [14]. The name Chemcatcher® appears only in 2007 when the trademark was deposited. Since, this tool has been

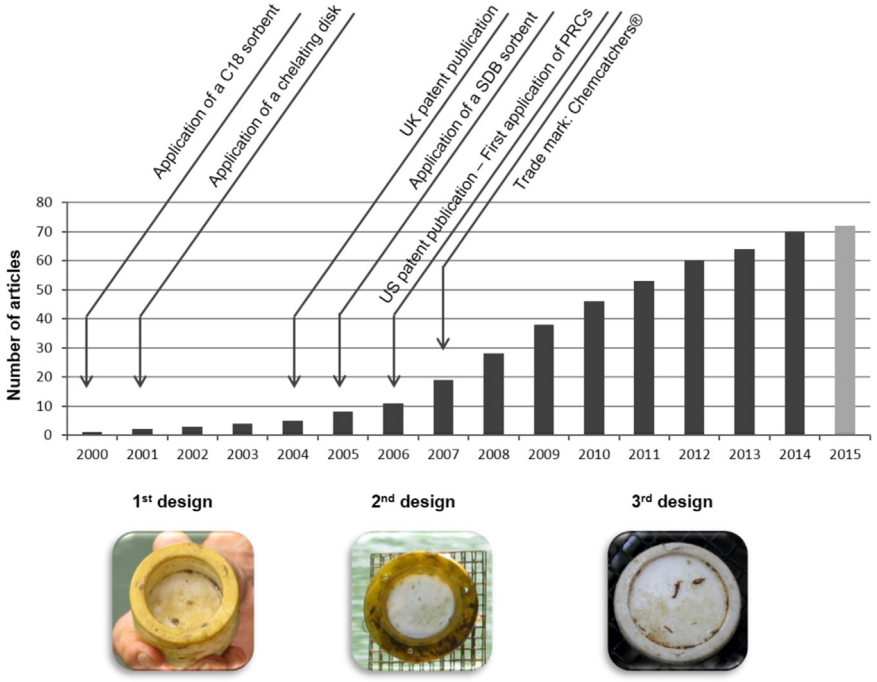

Fig. 1. Main steps and publication history for the development and uses of the Chemcatcher®.

Download English Version:

https://daneshyari.com/en/article/1243820

Download Persian Version:

https://daneshyari.com/article/1243820

Daneshyari.com