Acceptance and Use of Passive Sampler Data in Regulatory Environments

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Things have changed

- Passive sampling is not new.
- There are many applications.
- Passive sampling is not unproven. Particularly for non-ionic organic compounds.
- When properly done, passive sampling better characterizes dissolved phase than media grab samples.
- Passive sampling is being used by Agency PMs and researchers.
- Passive sampling is used in regulatory applications.
Passive Sampling is Not New

- 1987 - Södergren, A. (Univ. of Lund, Sweden) Dialysis membranes filled with hexane. (DDX, PCBs, HCB)
- 1990 – Huckins et al. published articles in several peer reviewed journals on SPMDs
- 1992 – Lebo et al. more SPMDs (PAHs)
- 1994 – Lebo et al. SMPDs for PCDD/Fs.
Passive Sampling is Not New

- 2000 – Adams et al., Polyethylene sheets
- 2001 – Jonker et al., Polyoxymethylene (POM) sheets
- 2002 – Booij et al., Spiking PRCs on PE Samplers
- 2005 – Hawthorne – Isotope Dilution-Flocculation-SPME.
There are many applications

- Semipermeable Membrane Devices (SPMDs)
- Polyethylene Diffusion Bag Samplers (PDBs)
- Rigid Porous Polyethylene Samplers (RPPS)
- Polar Organic Chemical Integrative Samplers (POCIS)
- Passive In-Situ Concentration Extraction Sampler (PISCES)
- Peepers
- Regenerated-Cellulose Dialysis Membrane Samplers
- Nylon-Screen Passive Diffusion Samplers (NSPDS)
- Passive Vapor Diffusion Samplers (PVDs)
- Polymeric sheets, Gschwend, Fernandez, Burgess, Jonker
- AGI (formerly GORE® Sorbers)
- In situ SPME, Reible et al. In vitro SPME, Hawthorne et al
- XAD Bead Kinetics Studies
Better characterizes dissolved phase non-ionic organics

FIGURE 1. Diagram of Important Sediment Phases Affecting the Bioavailability of PAHs in Sediments
Partitioning cannot be simply modeled – $K_{OC}$ must be measured

Hawthorne et al., 2006
In vitro SPME is better at characterization of dissolved phase
Passive is better at predicting PAH accumulation by softshell clams

Figure 1. Ratios of concentrations in *Mya arenaria* predicted by biota-sediment accumulation factors (BSAF) or polyethylene (PE) passive sampling methods to those measured in clams from all sites, excluding Island End, where clam and sediments and polyethylene were not colocated (*n* = 26). Colored bars indicate the average of ratios in individual clams (*N* = 26), whereas error bars indicate ±1 standard deviation of those ratios.

Fernandez, L., Gschwend, P., ET&C (34), 5, 2015
Regulators are increasingly recognizing that risk assessments of soil and sediments should account for bioavailability:

- Dutch Soil Quality Assessment Framework
- Ontario Ministry of the Environment (POCIS Study of PPCPs, EDS in Lake Ontario, 2010)
Agencies use forms of passive sampling for regulatory applications

- 2007 - USEPA NRMRL, USEPA Region III, USEPA ORD, USGS, WVDEP, and VADEQ TMDLs for PBTs, developed primarily using passive sampling.

- NYSDEC DER-10 Guidance on conducting acceptable investigations and remediation included PDBs as standard.
Applications in Regulatory Environments

- Palos Verdes Shelf Superfund Site - Region 9 – Part of the Feasibility Study Plan (May 2009) Several publications
- United Heckathorn Superfund Site – Region 9 – Part of the post remediation biomonitoring program
- Sangamo Weston, Inc./Twelve-Mile Creek/Lake Hartwell Superfund Site – Region 4 – SPMDs as part of the Aquatic Biota and Sediment Monitoring program. 2009 (Phase 3)
- Lake Ontario LaMP Program – PISCES samplers used in multiple studies for trackdown of PCB loadings to the lake. USEPA and NYSDEC cooperated mid 90s to early 2000’s.
Updates from Palos Verdes

□ 2012 ES&T – Fernandez et al. deduced water concentrations from SPME and PE at Palo Verdes Superfund site. Determined that DDX and PCBs exceeded Water Quality Criteria

□ Future monitoring to determine the effectiveness of remedial activities.

□ 2014 ES&T – Fernandez et al. sediments remain a source of contamination to water column above a pilot sand capped area due to molecular diffusion. (DDX, PCBs in POM, PE)
December 2012 EPA Published - Guidelines for Using Passive Samplers to Monitor Organic Contaminants at Superfund Sediment Sites – notes passive samplers “are useful new tools for assessing contaminant exposures and evaluating the potential for adverse environmental effects at Superfund sites.”

“… can provide faster, cheaper, and more scientifically-sound information about the dissolved water column and interstitial water concentrations of hydrophobic organic COC at Superfund sites.”
Passive sampling is well established in literature, both for exposure assessment and as a potential surrogate for uptake studies.

Guidance is in place for many applications.

State and USEPA project managers have recognized the value and are applying the approach in multiple regions.

The validation of passive samplers as a predictor of uptake and exposure has surpassed in several cases the traditional approaches (sediment or water grab sampling and modeling).
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