

Theme Session J

Applications of passive sampling devices in environmental monitoring, assessment, research and testing

ICES CM 2007/J:01

Measurement of the availability of polycyclic aromatic hydrocarbons (PAHs) in marine sediments and pore-waters from Loch Leven, Scotland using silicone rubber passive samplers

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The sediments of Loch Leven, Scotland contain high concentrations of PAHs and have been monitored by Fisheries Research Services since 1999. The contamination has been attributed to the effluent discharged from an aluminium smelter at Kinlochleven, which ceased operation in June 2000. The availability of PAHs in sediments collected from 5 points along the loch in 2006 was assessed using silicone rubber passive samplers, following protocols developed through the ICES Working Group on Marine Sediments. The total (2- to 6-ring, parent and branched) measured PAH concentration in the 5 sediments ranged from 13,282 to 95,158 ng/g dry weight with concentrations in the 3 sediments from the upper basin of the loch a factor of 8 higher than those found in the 2 sediments from the lower basin. The 4- to 6- ring compounds accounted for ~ 95% of the PAHs found in both basins, with a dominance of the 5-ring compounds (~ 45%). Results from the laboratory application of silicone rubber passive samplers provide estimates of the free dissolved concentrations of PAHs in pore water, and also of the fraction of the total concentration of PAHs in the sediment that could potentially be mobilised into the pore water. The method also allowed for the estimation of site specific sediment-water partition coefficients. These information aids in the assessment of environmental risk arising from contamination from smelter discharges.

Keywords: silicone rubber, PAHs, passive sampler, free dissolved concentration.

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ICES CM 2007/J:02

ICES Passive sampling trial survey for water and sediment (PSTS) 2006–2007. Part 1: Objectives, Design and Realization

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In 2006, the ICES WGs on Marine Sediments and Marine Chemistry agreed to establish a joint Coordinating Group to organize a collaborative trial of the use silicone rubber passive samplers in water and sediment. Twelve laboratories from ICES countries (and one from Australia) joined the project,

The preparatory work to gain commitment from participants, prepare a protocol for the trial, prepare materials for deployment in the field, and distribute them to the laboratories closely followed the projected timetable from April to September 2006. This involved a large amount of work by the central laboratory to prepare 600 sampler sheets and 100 sediment sampling bottles. The final distribution of equipment and materials to participating laboratories was made on 29 September 2006; only four days later than planned.

Deployment of samplers in the field was planned to begin in early October, but was delayed in some laboratories with the final deployment occurring on 10 November. This delay was inevitably reflected in later aspects of the project, i.e. the sending of samples to the central laboratory for analysis, analyses in-house and by the central laboratory, and the reporting of data to the coordinator. Final samples for analysis were not received by the coordinator until March 2007 (target December 2006 – January 2007). All analyses will be completed by the end of April 2007. The primary target analyses for the project were polycyclic aromatic hydrocarbons (PAHs) and chlorobiphenyls (CBs). This paper describes the organizational structure established for the project, the activities involved, and the experimental design.

Keywords: passive sampling, intercomparison, water, sediment, PAH, CB.

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ICES Passive sampling trial survey for water and sediment (PSTS) 2006–2007. Part 2: Laboratory intercomparison, analytical issues and lessons learned

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International intercomparison of passive sampling has not yet been attempted on a wide scale. Thirteen laboratories, spread widely through Europe participated in the PSTS, including one laboratory from Australia. Replicate passive samplers and sets of sampling equipment were prepared at a central laboratory and distributed to participants. After duplicate exposure of the samplers to environmental matrices (water and sediment) from a wide range of locations, one sampler for each matrix was retained by the participants for analysis and the duplicates were sent to the coordinating laboratory to be analysed. This design permitted intercomparison of participants' performance through comparison with the results obtained by the more experienced central laboratory.

Samplers and data were returned to the central laboratory between December 2006 and April 2007. The target analytes for the intercomparison element of the project were polycyclic aromatic hydrocarbons (PAHs) and chlorobiphenyls (CBs). This paper presents an initial analysis of the between-laboratory intercomparisons for these groups of priority micropollutants.

Keywords: passive sampling, intercomparison, water, sediment, PAH, CB.

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ICES Passive sampling trial survey for water and sediment (PSTS) 2006–2007. Part 3: Preliminary interpretation of field data

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Passive sampling of the water phase and sediment pore waters was carried out between October and December 2006 by thirteen laboratories at up to 31 locations through the PSTS project. The European locations covered estuarine and coastal environments from Norway to Portugal and west to Ireland and the Faeroe Islands. Also, two locations in Brisbane, Australia were sampled. The free dissolved or available concentrations of hydrophobic organic contaminants in the aqueous phases (water column and pore water) are estimated from the uptake by passive samplers.

Samplers made of silicone rubber sheets were exposed to water in the field for periods of around 6 weeks. Sediment samples were shaken for around 3 weeks in a bottle coated with a layer of silicone rubber in the laboratory environment. The exchange process of both sampler types was monitored using performance reference compounds spiked on the samplers. Some initial interpretation for polycyclic aromatic hydrocarbons (PAHs) and chlorobiphenyls (CBs) has been made.

Available concentrations for individual PAHs in water ranged over 3 orders of magnitude. Notably high concentrations were found in Norwegian areas close to aluminium smelters. A remarkable finding was that in the outer parts of the Scheldt, concentrations of lighter PAHs increased seawards, while more heavier PAHs showed a decrease. Possibly this is related to atmospheric input that remains more in the water phase in open sea where in the estuarine water suspended particulate matter may bound the deposited PAHs.

Concentrations in sediment pore waters reflected known contamination of the Seine and the Scheldt with CBs, and the Elbe with hexachlorobenzene. Low concentrations were found in Norway and Scotland; these areas are likely to be remote from inputs.

Keywords: passive sampling, PAH, CB, North Sea, water, sediment.

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Passive samplers for hydrophobic contaminants in water: concepts and interpretations

Kees Booij and Foppe Smedes

Passive samplers for assessing sources and fate of hydrophobic organic contaminants have been applied in water for about two decades, and many types of samplers have become mature. The features of these samplers are well understood: the principles of operation, the factors that control the uptake rates, the models that are needed for estimating aqueous concentrations from the absorbed amounts, and the methods for estimating in-situ sampling rates. A conceptual difficulty with passive sampling techniques (compared with

filtration/extraction methods) is that it is somewhat more difficult to develop a clear idea about the water volume that effectively is extracted during the exposure period, particularly because this effective volume is compound dependent. An additional difficulty is that the extent to which the sampling is time-integrative also depends on the compound. In this contribution, we present some simple methods to estimate the effectively extracted water volume. These methods are helpful for strengthening the conceptual link between passive sampling and filtration/extraction techniques and for minimising the risk of calculation errors during data processing. In addition, these methods yield an estimate of the time window over which sampling is time-integrative.

Keywords: semipermeable membrane devices, low-density polyethylene, silicone, strip samplers, water, hydrophobic contaminants, sampling, in situ calibration.

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Particle association and bioavailability of PAHs related to coal tar pitch assessed by passive samples

Kristoffer Næs, Anders Ruus, Olav Bøyum, and Merete Grung

Passive samplers have been used for assessing water-sediment partitioning and actual bioaccumulation of PAHs in sediments influenced by coal tar pitch from Nordic aluminium smelters. The results showed that the PAHs associated with the sediments were stronger (a median factor of at least a magnitude) adsorbed/absorbed to the particles than free energy relationship implies. This further implies that the bio available fraction is correspondingly lower, and one would expect lower bio accumulated concentrations. The accumulated concentrations measured in *Nereis diversicolor* and *Hinia reticulata* were in fact very similar to biota concentrations expected based on the POM-deduced sediment-water partitioning coefficients. Thus, the measured biota to sediment accumulation factors (BSAFs) agreed also very well with those expected from the POM-deduced sediment-water partitioning coefficients. On the other hand, this good correspondence was not observed for the third species, the bivalve *Nuculoma tenuis*. There were however logistical intractabilities connected to this species biology and size that render it probable that particulate sedimentary matter contaminated the *Nuculoma* tissues analyses.

Keywords: passive samplers, bioavailability, PAHs, aluminium smelters.

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Methods using passive sampling techniques in sediment for the estimation of pore water concentrations and available concentrations for hydrophobic contaminants

Foppe Smedes

Hydrophobic contaminants entering the aqueous environment will generally sorb to particulate matter in water phase and sediment due to their low water. Sediment is often considered as a sink and/or buffer for hydrophobic contaminants. The risk of sediment contamination is related to what the sediment can release to the water phase, rather than the total concentration in that sediment. This is described by two parameters; (1) the porewater concentration and (2) the concentration on the sediment that is available for release to the water phase. Techniques like Solid Phase Micro Extraction (SPME), Polyethylene- (PE), Silicon rubber- and POM-Solid Phase Extraction are applied to determine the pore water concentrations. TENAX extractions are used to estimate the available fraction and In-vitro Passive Sampling (IVPS) gives an estimate of both pore water and available concentrations. Consequently partition coefficient of that available concentrations are determined as well. The availability concept and how the different methods contribute to obtaining information on availability for uptake or transport will be discussed.

Keywords: passive sampling, water, sediment, SPME, POM-SPE, TENAX, IVPS

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Calibration of passive sampling devices for hydrophobic organic contaminants

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Application of passive samplers for monitoring of hydrophobic organic contaminants (HOCs) requires calibration data that relate absorbed amounts in the sampler to dissolved aqueous concentrations. Therefore,

prior deployment in the environment passive samplers should be calibrated to determine sampling rates (Rs) for the target compounds under controlled conditions in the laboratory. There are a number of approaches for dosing systems that are applied to calibrate samplers providing necessary non-depleted situation. Dosed nominal values are normally reduced because of the sorption effects of HOCs on the surface of glassware and sorption to particulate matter and dissolved organic carbon fraction. Therefore, all present methods depend on accurate determination of very low freely dissolved water concentration of HOCs. Overestimation of dissolved water concentration easily occurs and may lead to a larger underestimation of sampling rates with increasing Kow, particularly for log Kow > 6. The present study investigates the Rs-logKow relation without direct measurement of dissolved water concentrations. An excess number of spiked silicone rubber sheets with known contaminant concentration is used for dosing the water. Dissolved water concentration can be predicted from the known water-silicone rubber partition coefficients. The uptake rate of non-spiked passive samplers is used to calculate the sampling rate. This concept simplifies the calibration procedure and can be used for investigation the uptake process of HOCs by any passive sampling material.

Keywords: sampling rate; silicone rubber; calibration; dissolved concentration; uptake rate.

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Passive samplers as sediment surrogates in toxicity tests

Marion Nipper, R. Scott Carr, Jim Biedenbach, John MacFarlane, and Philip Gschwend

Marine sediments and pore waters contaminated with hydrophobic organic compounds (HOCs) act as a dynamic system, where the sediment is a constant source of HOCs to the surrounding environment and associated benthic fauna. Laboratory toxicity tests using pore water lack the sediment "buffering" capacity, possibly underestimating the potential toxicity of HOCs due to lack of the necessary mass of dissolved contaminants in pore water to achieve the critical body residue that would cause adverse biological effects. Media that absorb HOCs can be used as sediment surrogates, acting as constant sources of HOCs in toxicity tests. A thin polyethylene (PE) film was used for this purpose. PE was exposed to contaminated sediments, transferred to uncontaminated filtered seawater, allowed the necessary time to reach equilibrium, and used in toxicity tests. This system allows better control of the HOC dose concentration while removing complications from other potentially toxic porewater components such as metals, ammonia and sulfides. Toxic effects to sea urchin early life stages and copepod hatching success were assessed using pore waters and HOC-loaded PE systems from the same sediments. Toxicity of actual pore water differed from toxicity of HOC-loaded PE systems. This was possibly due either to lack of a sufficient mass of HOCs in the porewater to cause toxic effects, in which case the PE system was more toxic than the pore water, or to the presence of different categories of contaminants in the actual pore water, in which case the pore water was more toxic than the PE system.

Keywords: hydrophobic organic contaminant, toxicity test, passive sampler, polyethylene, sea urchin, copepod.

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Passive sampling devices to assess the diffusive transfer of persistent hydrophobic organic contaminants at the sediment-water interface in the coastal marine environment

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Persistent hydrophobic organic contaminants accumulate in the coastal marine environment and can enter trophic webs. In marine ecosystems, the sediment-compartment may act as a burial sink and also as a diffusive source of contaminants to water and organisms. For a better understanding of the fate and bioavailability of contaminants at the sediment-water interface, we studied the biogeochemical behaviour of various model hydrophobic organic contaminants (polycyclic aromatic hydrocarbons PAHs and polychlorinated biphenyls PCBs). The site studied is a Mediterranean lagoon located south of France. This lagoon presents an intensive shellfish farming activity and receives input from different human activities, i.e. urban activities, industries, port activities and agriculture. Two types of passive sampling experiment with low-density polyethylene (LDPE) strips were carried out to assess the diffusive mobility of PAHs and PCBs. Firstly, LDPE strips were exposed in laboratory conditions to sediments collected in the lagoon. The analysis of these strips enables us to determine the freely dissolved concentration of contaminants in porewater. Another type of experiment was conducted by exposing LDPE strips to the overlying water column, in situ at the sediment-water interface. Using this combined approach based on passive sampling techniques, concentrations of freely dissolved persistent organic contaminants were determined to assess their diffusive

exchanges at the sediment-water interface. These experiments provide field data for the fate and ecological modelling of organic contaminants in the Thau lagoon. These data may also serve to better assess environmental quality standards for marine coastal sediments.

Keywords: passive sampling, LDPE, sediments, organic contaminants, diffusive transfer.

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The INRAM project

Patrick Roose

In Belgium a 4 year project called INRAM (Integrated Risk Assessment and Monitoring of micropollutants in the Belgian coastal zone) is currently underway. The project is financed by the Belgian Federal Science Policy Office and aims to assess in an integrated approach the risks of micropollutants to Belgian coastal zone ecosystems and man. Passive sampling will be used as an innovative approach to measure contaminant pressure in the environment. During the project, a large group of hydrophobic organics will be measured at nine sampling points with passive samplers. Passive sampling will also be used as a tool for in lab toxicity tests at constant and environmentally relevant concentrations. Through the 'reverse' use of passive samplers toxicity assays will be performed with complex mixtures of contaminants.

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Polyoxymethylene solid phase extraction as a predictor for bioavailability of model compounds in the sediments from three rivers in the Europe

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The European Water Framework directive (WFD) demands for a good ecological status of European surface waters by 2015. Modelkey project has been built to assess and forecast the impact of pollutants on freshwater and marine ecosystems. One part of project is to evaluate bioaccumulation of model compounds in spiked sediment samples from three river basins. The river Elbe is a large central European river basin, and is situated in the Czech Republic and Germany. The River Schelde is situated in France, Belgium and the Netherlands. The river Llobregat is situated in the North-East part of Spain. All river basins have been modified by anthropogenic influences.

Bioaccumulation of 2,2',4,4'-tetrabromo diphenylether (TBDE), 3,3',4,4'-tetrachlorobiphenyl (TCBP), pyrene and chlorpyrifos was measured by exposing standard test species *Lumbriculus variegatus* (Oligochaeta) in 20 different sediments. In addition to bioassays, polyoxymethylene (POM) solid phase extraction was used to determinate freely dissolved pore water concentration, assuming equilibrium between POM, sediment organic carbon and water. As assumed in Equilibrium partitioning theory, pore water concentration can be taken advantage to predict bioavailability of model compounds ($C_a = BCF \cdot C_w$). Bioconcentration factors (BCFs) were attained from equation $\log BCF = 1.01 \cdot \log Kow - 0.07$.

Method was suitable for pyrene, TCBP and TBDE. However, observed chlorpyrifos tissue concentrations showed a clear deviation from predicted tissue concentration. The results support POM-extraction predicted pore water concentrations as a mean to estimate bioavailability of sediment associated contaminants.

Keywords: POM, pore water, bioavailability, sediment .

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Porewater concentrations of PAHs in dredge spoils from Scotland

I. M Davies, M. Kennedy, K. Yates, and P. Pollard

Fisheries Research Services Marine Laboratory (FRS) is responsible for the licensing of deposition of wastes such as dredged spoils in UK waters adjacent to Scotland, under Part II of the Food and Environment Protection Act 1985. This includes the chemical assessment of potential deposits as well as assessment of the locations after deposition. Dredged harbour sediments being considered for disposal at sea are traditionally

analysed for total concentrations of polycyclic aromatic hydrocarbons (PAHs), chlorinated biphenyls (CBs) and metals and are assessed based on sediment quality criteria or guidelines. As part of the progressive development of the licensing process, FRS has assessed the availability of PAHs in dredged sediments collected from 6 locations in the Firth of Clyde, Scotland (which, due to industrial and domestic inputs is arguably considered Scotland's most contaminated water body) using silicone rubber passive samplers, following protocols developed through the ICES Working Group on Marine Sediments. Comparison of the concentrations of PAHs in porewater is made with sediment collected from Telford Dock, Aberdeen harbour (a busy harbour for vessels linked with the North Sea oil and gas and fishing industries as well as ferries to and from the Northern Isles), UK. Porewater concentrations in sediments from the Clyde ranged from 2.10 (dibenz[a,h]anthracene) – 65,105 (2,6-dimethylnaphthalene) pg/l and these were factors of 0.5 to 7.1 higher than the concentrations found in Aberdeen harbour.

Keywords: dredge spoils, silicone rubber, PAH, passive sampler, pore water concentration.

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Does Tenax extraction based desorption measure bioavailability of sediment-associated contaminants?

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Tenax-resin has been originally developed for grabbing volatile organic from gases. The resin is a porous polymer (2,6-diphenyl-p-phenylene oxide) and it has low affinity for water (floats on the surface). It has high affinity for HOCs, thus capturing efficiently freely dissolved HOCs. On the other hand, the HOCs can be quite easily be extracted from Tenax for analysis. Due to these properties Tenax has been applied to measure desorption of hydrophobic organic contaminants (HOCs) in sediment- (and soil-) water systems. The Tenax extraction has indicated that HOCs sorbed to sediments can be modeled to belong to 2 or more compartments on the basis of rate of desorption (for example rapid, slow and very slow fractions). Following this it has been anticipated that mainly the rapidly desorbing fraction, obviously containing also the freely dissolved fraction, would be bioavailable. Several studies have been conducted to determine if Tenax extraction based desorption could be used to predict bioavailable fraction in sediments. In many cases the laboratory studies indicated that there is a relationship between the size of rapidly desorbing fraction or rate constant for the rapid fraction and bioavailability. However, there are some issues that we must be aware when using Tenax extraction. For example, it appears that ecological factors, such as species life and feeding habits affect the bioavailability in ways that cannot be detected by Tenax extraction.

Keywords: tenax, sorption, desorption, sediments, bioavailability.

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Determining the Sources of Polychlorinated Biphenyls to Demersal Fish in Narragansett Bay, RI, USA

Eric Morgan and Rainer Lohmann

In order to better understand the bioaccumulation of polychlorinated biphenyls (PCBs) in an estuarine system, demersal fish samples were taken biweekly from May to November 2006 for analysis of bulk PCB concentrations in Narragansett Bay, an urbanized estuary on the northeastern coast of the USA. Lipid normalized concentrations were widely variable between species and feeding strategies, ranging for total PCBs ~5ng/g lipid dry weight to ~5000 ng/g lip dry weight. Fish samples were also analyzed for three stable isotopes, ¹³C, ¹⁵N and ³⁴S as a quantitative comparison of dietary composition. This three isotope approach provided more rigor for comparisons of dietary composition between organisms with different feeding strategies than the traditional single or dual isotope approach, improving constraints of dietary composition and estimates of similarity of diets (and hence dietary sources of PCBs) between species. To assess the extent of bioconcentration, polyethylene passive sampling devices (PSDs) were deployed biweekly in a vertical array at each location, with one sampler above the sediment bed, one in the water column, and one in the near-surface air. From the PSDs the concentration of the freely dissolved (or vapor phase, in the case of air), bioavailable fraction of PCB was derived. Activities were typically between 10⁻¹⁰ and 10⁻⁷. By comparing congener profiles of PCBs as measured by the PSDs to tissue congener profiles and stable isotope signatures, the bioaccumulation of PCBs in demersal fish in the Bay were assessed based on their exposure route (bioconcentration or biomagnification) and source (sediment, water column, or air).

Keywords: polychlorinated biphenyls, bioaccumulation, passive sampling, stable isotopes.

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ICES CM 2007/J:16**Experience with DGT samplers in marine samples at NIVA**

Oddvar Røyset

NIVA have studied the DGT samplers (Diffusive Gradients in Thin films) since 2001 in both freshwater and in seawater. They are useful for most common heavy metals in seawater (Pb, Cd, Cu, Zn, Ni, Co, Al, Fe, Mn etc). The last years we have also studied the DGT sediment probes for porewater concentration in the top 10-15 cm of marine sediments. These give new information about the release of metals and also give nice redox induced release profiles for especially Fe and Mn in top sediments. Experiences with the DGT samplers for marine applications will be discussed in the presentation.

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ICES CM 2007/J:17 Poster**Availability of PAHs in sediments from the Vefsn Fjord, Norway to the rag worm, *Nereis virens***

K. Yates, I. M Davies, L. Webster, P. Pollard, L. Lawton, and C. F. Moffat

The Vefsn fjord in Northern Norway has received discharges containing polycyclic aromatic hydrocarbons (PAHs) for many years, in particular from smelting processes at Elkem Aluminium Mosjøen. Measurements of the availability of PAHs in sediments collected at 3 different points along the Vefsn fjord were made using silicone rubber passive samplers. The results were compared to direct measurements of the accumulation of PAHs by the marine polychaete, *Nereis virens* experimentally exposed to the contaminated sediments. Sorption isotherms for the passive samplers were obtained by equilibrating silicone rubber strips and sediment slurries at a range of different ratios. These were used with silicone rubber-water partition coefficients, to calculate the free dissolved concentrations of PAHs in the sediment pore water, and also to estimate the available fraction of the total concentrations of PAHs in the sediment that could potentially be mobilised into the pore water. The sediments were dominated by the 4- (~ 32%), 5- (~ 40%) and 6- (~ 20%) ring PAHs, which is typical of sediments from around aluminium smelters. The 4 to 6-ring compounds accounted for 93, 96 and 85 % of the PAH concentration in *N. virens* with a higher dominance of the 4 ring compounds (69%) at station 1 while the 5- and 6-ring PAHs dominated at stations 3 and 8 (~ 43% each).

Keywords: silicone rubber, PAH, passive sampler, free dissolved concentration, *Nereis virens*.

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ICES CM 2007/J :18 Poster**Biofouling in passive samplers**

Lucía Viñas, Ángeles Franco, Kristoffer Naes, and Foppe Smedes

During the ICES Passive Sampling Trial Survey 2006–2007 passive samplers were deployed in different stations distributed along European Atlantic coast from Portugal to Norway. The diverse environmental conditions present in the different sampling sites caused very different degrees of biofouling after the period of exposure (6-8 weeks). Two clearly extreme cases were represented by the Spanish samplers deployed in Rodeira (Ría de Vigo, NW Spain) which were completely overgrown and the Norwegian ones at Karmsund and Vefsnfjord that were nearly clean when recovered. The impact of the biofouling on the samplers and the feasibility to use biofouled devices were studied in terms of the release of the performance reference compounds (spiked on the sampler before exposure) and consequently the effect on the sampling rate calculation.

Keywords: water, hydrophobic contaminants, passive sampling, biofouling.

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ICES CM 2007/J:19 Poster**Six years of monitoring PCBs and PAHs by passive sampling in parallel with deployed mussels.**

Foppe Smedes and Karin Koning

Free dissolved concentrations of hydrophobic contaminants are considered to represent the driving force for uptake by organisms. Measuring free dissolved concentrations of PCB and PAH concentrations by classical extraction is generally disturbed by amounts of those compounds adsorbed to particulate and dissolved organic matter present in regular grab samples. Therefore since 1989 the RIKZ is monitoring marine water quality using deployed mussels. The last six years passive samplers made of silicone rubber were added to the program. In contrast to mussels the samplers do not have a start concentration, do not metabolize and applicable over the whole salinity range. The results show that free dissolved water concentrations of PCBs and PAHs recalculated from the uptake by passive samplers are proportional to the concentrations in mussel tissue. This can be expressed as a BioAccumulation Factor (BAF). For the BAF values no significant seasonal or spatial differences were observed indicating that passive samplers may be a good alternative for mussels in water quality monitoring

Keywords: passive sampling, water, musselwatch, bioaccumulation factor, PCB, PAH.

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ICES CM 2007/J:20 Poster**Use of the Sediment Profile Imaging and Micro-Sampling System (SPIMS) for delineating study areas for in situ bioaccumulation investigations**

R. Scott Carr, Marion Nipper, and Phil Gschwend

We are utilizing the Sediment Profile Imaging and Micro-sampling System (SPIMS) to direct the efficient in situ use of passive polyethylene-based samplers. These samplers are designed to evaluate the bioavailable quantities of hydrophobic organic compounds (HOCs) in bedded sediments. The SPIMS uses real time digital imagery to guide the positioning of the micro-measurements and sampling of precise depths and features in the sediment profile. The SPIMS includes (1) the use of digital imagery with LED illumination for real time visualization through a fiber optic connection as well as high resolution images of the benthic biota, (2) a series of robotic microsensors for measuring in situ dissolved oxygen, redox, pH, various metals and other parameters which can be measured with an electrode, (3) a robotic sampling system which allows sediment and pore water to be sampled at discrete locations, and (4) in situ placement of PE samplers within the visible sediment profile. To differentiate between narcosis effects and other types of toxicity (e.g., due to ammonia or metals), toxicity tests and toxicity identification evaluation (TIE) studies with sea urchin gametes and benthic copepods are also being conducted using (a) pore waters with their dissolved HOC loads and (b) polyethylene (PE)-sorbed HOCs obtained by equilibrating the PE and sediments from the same locations. High resolution sediment profile images in conjunction with GCxGC analyses of HOCs and toxicity data from PE samplers should provide the information necessary to rapidly and accurately establish the boundaries of areas affected by HOC contamination.

Keywords: hydrophobic organic compounds, toxicity test, passive sampler, polyethylene, sediment profile imaging.

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ICES CM 2007/J:21 Poster**Diffusion coefficients in some materials used for passive sampling – consequences for uptake mechanism.**

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Passive samplers are already widely applied to estimate concentrations of hydrophobic organic contaminants (HOCs) water but also sediment suspension. The uptake rate is basically controlled by two limiting barriers: (1) the boundary layer, a film of stagnant water and (2) the permeability or resistance to transport inside the membrane. The slowest process is controlling the uptake. Compounds well soluble in water diffuse in larger amounts through the boundary layer and transport is than often limited by the diffusion in the membrane. For more hydrophobic compounds fewer molecules are in the waterphase and consequently the mass passing the boundary layer will be smaller while the transport abilities in the material are less affected by an increasing hydrophobicity. Boundary layer controlled sampling is considered to be the preferred situation as the sampler will behave as a “volume” sampler under given hydrodynamic conditions. The relative importance of the boundary layer and the membrane transport for the uptake processes are assessed for a wide hydrophobicity range using measured diffusion coefficients for PAHs (and partly PCBs) in LDPE, POM and PDMS.

Keywords: diffusion coefficients; silicone rubber; LDPE, POM; PCBs; PAH; uptake rate.

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