Sample Shipping

The POCIS should be transported to and from the sampling site in air-tight containers to prevent potential contamination from airborne chemicals. When possible, the POCIS should be shipped cold to preserve sample integrity.

Future Considerations

1. Determination of additional sampling rate data. Sampling rates are necessary to estimate the ambient water concentration of targeted chemicals. To date, a limited number of chemical sampling rates have been determined.

2. How to incorporate the Performance Reference Compound (PRC) approach into the POCIS. A PRC is a compound which is added to the POCIS during construction and is lost to the surrounding water during deployment. Determination of the amount of PRC lost provides an environmental adjustment factor to correct laboratory-derived sampling rates for the site-specific environmental factors. Initial studies indicate careful selection of the PRC and the sorbent used in the POCIS is necessary to allow measurable loss of chemical. This PRC approach has successfully been used with semipermeable membrane devices (SPMDs)

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Information and Contacts

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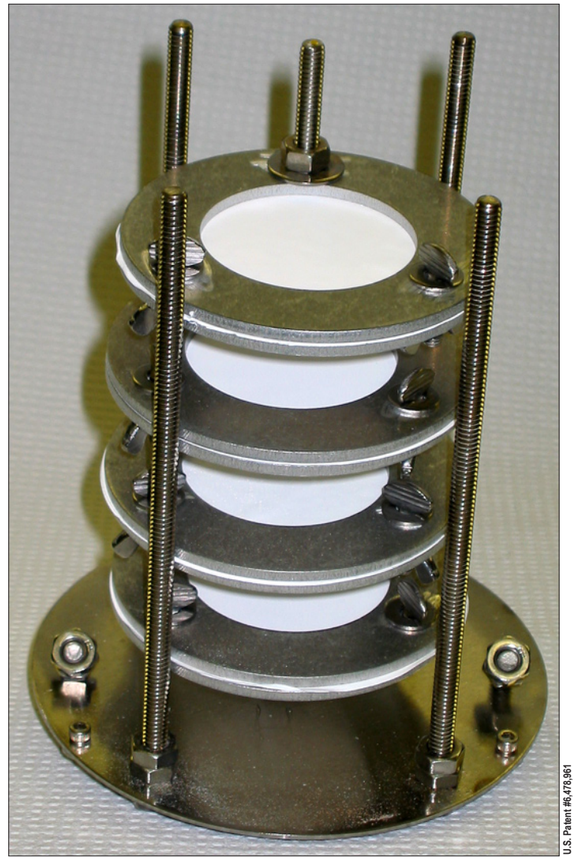
Polar Organic Chemical Integrative Sampler (POCIS)

Description and Application

Brief Background

The Polar Organic Chemical Integrative Sampler or POCIS is designed to sample water-soluble (polar or hydrophilic) organic chemicals from aqueous environments. The POCIS is an integrative sampler which provides time-weighted average concentrations of chemicals over deployment periods ranging from weeks to months. This device is a passive sampler meaning that it has no mechanical or moving parts, requires no power nor supervision during use. The POCIS samples chemicals from the dissolved phase, mimicking the respiratory exposure of aquatic organisms. The POCIS provides a highly reproducible means for monitoring contaminant levels, and it is largely unaffected by many environmental stressors that affect biomonitoring organisms. The POCIS also enables *in situ* concentration of trace organic contaminant mixtures for toxicity assessments and toxicity identification evaluation (TIE) approaches.



Four POCIS are shown mounted in a stainless steel deployment canister. Each POCIS has a sampling surface area of ≈ 41cm². Generally, POCIS of different configurations are deployed together inside a single protective canister to maximize the types of chemicals sampled. NOTE: The canister's outer protective screen was removed for picture clarity.

Physical Characteristics

The POCIS consists of a solid material (sorbent) contained between two microporous polyethersulfone membranes. The membranes allow water and dissolved chemicals to pass through to the sorbent where the chemicals are trapped. Larger materials such as sediment and particulate matter are excluded. The membrane resists biofouling which can significantly reduce the amount of chemical sampled. The type of sorbent used can be changed to specifically target certain chemicals or chemical classes. A standard POCIS consists of a sampling

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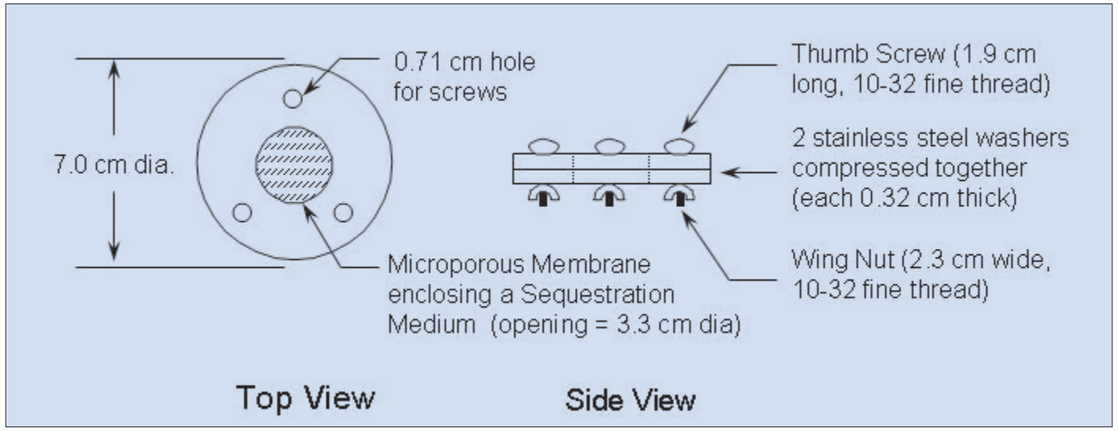
U.S. Department of the Interior
U.S. Geological Survey

November 2004



View of a POCIS. The sorbent is contained between two membrane disks. Upper and lower support rings are used to seal the device and prevent any loss of sorbent. Larger POCIS can be used to increase the volume of water sampled by maintaining the sampling surface area to sorbent mass ratio of ≅ 180 cm^2/g.

surface area (surface area of exposed membrane) to sorbent mass ratio of ≅ 180 cm^2/g. A typical field deployed POCIS has an effective sampling surface area of 41 cm^2.

Two configurations of the POCIS are commonly used, each containing different sorbents. A "Generic" configuration contains a mixture of three sorbent materials and is used for most pesticides, natural and synthetic hormones, many wastewater-related chemicals, and other water-soluble organic chemicals. The "Pharmaceutical" configuration contains a single sorbent designed for sampling most pharmaceutical classes. It is common to deploy POCIS of several different configurations together to maximize the types of chemicals sampled.

POCIS deployments typically are for one month, however, depending on the study design, deployment times can range from weeks to months. Following receipt of an environmentally exposed POCIS, the device is extracted using standard techniques. The sorbent is transferred into a chromatography column where the sampled chemicals are recovered using an organic solvent. The types of solvents used are optimized for the sorbent and the targeted chemicals.

Following processing of the POCIS in the laboratory, the sample is an enriched extract in an organic solvent such as methanol, dichloromethane, etc. Depending on the desired use of the sample, additional processing (i.e., cleanup and/or fractionation) may be necessary.

POCIS extracts have been analyzed by various instrumental techniques, including HPLC, GC, GC/MS and LC/MS. Extracts have also been tested with various bioindicator tests such as Microtox® and the Yeast Estrogen Screen (YES) to determine the toxicological significance of the complex mixture of chemicals sampled by the POCIS.

Target Media

The POCIS can sample polar organic contaminants from water under nearly any environmental conditions.

Potential Target Analytes

Chemicals sampled by the POCIS can include complex mixtures of pesticides, prescription and nonprescription drugs, personal care and common consumer products, industrial and domestic-use materials and degradation products of these compounds.

Sample Volume

The volume of water sampled during a POCIS deployment is a function of the sampling rate for a particular chemical and the sampling duration. These sampling rates can vary with changes in the water flow/turbulence, temperature, and buildup of suspended solids on the sampler's surface. To satisfy certain detection limit requirements, the extracts from multiple devices can be combined thereby increasing the total volume of water sampled.

"State of the Art"

Stage of Development

Lab Testing

Optimization of the POCIS for the sampling of various classes of pesticides and pharmaceuticals has been performed in the laboratory. Characterization of various membrane materials and sorbent compositions resulted in the current configurations. Calibration of the POCIS to determine sampling rates for selected chemicals under different turbulence regimes led to the development of theoretical models to describe sampler performance.

Field Testing

The POCIS has been used in numerous field deployments across the United States and internationally. These deployments have ranged from stagnant pools to major river systems, clear natural springs to biologically-active wastewater streams, and freshwater to estuarine systems. Comparison of data derived from POCIS and traditional water sampling methods validate the ability of the POCIS to provide information on dissolved hydrophilic organic chemicals in the water.

Acceptance of Technology

The POCIS has been used by federal agencies including USGS, USEPA, and the US Fish and Wildlife Service for the monitoring of water-soluble organic contaminants in numerous studies across the United States. The Environment Agency of England and Wales has adopted the POCIS as part of their National Pesticide Study. The Environment Agency has also begun an accreditation process for the POCIS.

Plastic protective deployment canister containing six POCIS.

Features and Limitations

Deployment Considerations

Careful selection of the study site is important for a successful deployment. It is critical that the samplers be deployed where they will remain submerged, but not buried in the sediment, during the exposure period. Keeping the samplers shaded may prevent degradation of some light-sensitive chemicals. It is desirable to have the POCIS in areas with water movement to enhance sampling rates, but when possible, avoid deployments in the heaviest flow to prevent damage. The biggest danger to the sampler is vandalism. Keeping the samplers securely tethered, hidden, and out of areas frequented by people can help prevent vandalism.

Decontamination Requirements

Prior to initial POCIS construction, the sorbents, membrane, and hardware undergo a thorough cleaning to remove any potential interferences. Only minimal cleaning to remove sediments, etc., which may adhere to the surface is necessary following use and during sampler processing. This cleaning generally involves gentle scrubbing of the hardware surface with a soft brush.