

Passive Sampling Methods for Contaminated Sediments: State of the Science for Organic Contaminants

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ABSTRACT

This manuscript surveys the literature on passive sampler methods (PSMs) used in contaminated sediments to assess the chemical activity of organic contaminants. The chemical activity in turn dictates the reactivity and bioavailability of contaminants in sediment. Approaches to measure specific binding of compounds to sediment components, e.g., amorphous carbon or specific types of reduced carbon, and the associated partition coefficients are difficult to determine particularly for native sediment. Thus, the development of PSMs that represent the chemical activity of complex compound/sediment interactions, expressed as the freely dissolved contaminant concentration in pore water (C_{free}), offer a better proxy for endpoints of concern, such as reactivity, bioaccumulation, and toxicity. Passive sampling methods have estimated C_{free} using both kinetic and equilibrium operating modes and used various polymers as the sorbing phase, e.g., polydimethylsiloxane, polyethylene, and polyoxymethylene in various configurations, e.g., sheets, coated fibers, or vials containing thin films. These PSMs have been applied in laboratory exposures and field deployments covering a variety of spatial and temporal scales. A wide range of calibration conditions exist in the literature to estimate C_{free} , but consensus values have not been established. The most critical criteria are the partition coefficient between water and the polymer phase and the equilibrium status of the sampler. In addition, the PSM must not appreciably deplete C_{free} in the pore water. Some of the future challenges include establishing a standard approach for PSM measurements, correcting for nonequilibrium conditions, establishing guidance for selection and implementation of PSMs, and translating and applying data collected by PSMs.

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