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DIRECT MEASUREMENT OF FREELY DISSOLVED CHEMICALS VIA PASSIVE SAMPLING TO DETERMINE BIOAVAILABILITY IN SEDIMENTS

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ABSTRACT

For contaminated sediment sites, risk reduction is achieved primarily by reducing chemical availability in the biologically active zone. Successful achievement of this goal may be limited, however, by an incomplete understanding of chemical bioavailability. In contaminated sediments, and in the biologically active zone in particular, the fraction of contaminants that is not bound to the sediment, known as the freely dissolved fraction, determines chemical bioavailability. Thus, measurement of freely-dissolved concentrations is increasingly accepted as the best indicator of chemical bioavailability and potential toxicity in sediments. Improved measurement techniques could potentially make risk assessments and regulations both more accurate and economical.

In recent years, passive samplers have made sampling and measurement of freely dissolved hydrophobic organic contaminants (HOCs) in water and sediment interstitial waters (porewater) easy, reliable, and reproducible. Passive samplers offer several advantages over traditional porewater sampling methods: passive samplers require substantially less water volume, involve less sample handling and manipulation, avoid matrix effects commonly associated with traditional methods, are relatively easy to deploy, can lower costs per sample, and can reduce uncertainty in the characterization of the nature and extent of contamination. Finally, unlike traditional methods, passive samplers can be deployed in situ, providing real-time results.

In the past year, Ramboll Environ has been involved with multiple sediment projects that use passive sampler techniques. Polyethylene (PE) samplers were deployed at a contaminated sediments site in Philadelphia, Pennsylvania, to determine porewater polychlorinated biphenyl (PCB) concentrations. At a site in Baltimore, Maryland, a modified Hesslein in-situ pore water sampler, also known as a “peeper,” was used to measure chlorobenzene concentrations in sediment porewater. At a shipyard in Washington State, solid phase microextraction fibers (SPME) were used to measure PCBs in porewater, before and after an enhanced monitored natural recovery treatment using activated carbon was employed. We plan to discuss the current state of knowledge of different passive sampling techniques, methods, advantages and disadvantages of various commonly used samplers, and we will discuss case studies mentioned above.