

United States
Environmental Protection
Agency

Office of Solid Waste
and Emergency Response
Washington, DC 20460

EPA/542/B-00/002
April 2000

 **Subsurface Remediation:
Improving Long-Term
Monitoring & Remedial
Systems Performance**

Conference Proceedings

JUNE 1999



Conference Proceedings

Subsurface Remediation: Improving Long-Term Monitoring and Remedial Systems Performance

June 8-11, 1999, St. Louis, Missouri

(38) Simple, Inexpensive Diffusion Samplers for Investigating VOCs in Groundwater

By Don A. Vroblesky, Ph.D., US Geological Survey

A simple, inexpensive diffusion sampler can be used to sample a variety of environments for VOCs of environmental interest. The diffusion sampler consists of a vapor or water phase inside a polyethylene membrane. In its simplest form, the sampler can be a sealable sandwich bag available at local grocery stores. A box of these can be obtained for a few dollars. The principle of operation is based on the ability of polyethylene to readily allow diffusion of volatile organic compounds (VOCs), such as aromatic petroleum hydrocarbons and chlorinated solvents, while preventing the movement of water across the membrane. Thus, after sufficient equilibration time, the VOC concentrations of the air or water in the sampler achieve equilibrium with the VOC concentrations in the ambient water outside of the sampler. Recovery of the samplers and analysis of the contained vapor or water can be used to determine VOC concentrations in the ambient water. Analyses of the vapor-based samplers give relative concentrations of VOCs and can be done rapidly and inexpensively on field or laboratory gas chromatographs. Analyses of the water-based samplers have the advantage of providing dissolved concentrations of VOCs measurable by standard laboratory methods.

Diffusion samplers, consisting of air-filled 40-milliliter glass vials enclosed in sealable polyethylene bags, were successfully used in streambed sediment to determine the locations of fractures that were discharging contaminated groundwater to surface water. Because the samplers are diffusion-based, VOC concentrations within the samplers change as ambient VOC concentrations change. Thus, the periodic recovery and analysis of samplers from a single location of discharging ground-water contamination in a stream was useful in observing the rapid increase in contaminant discharge resulting from air-rotary drilling of a nearby well in a fractured-rock aquifer. Water-filled diffusion samplers can be used to quantify the concentrations in discharging groundwater. A test of this approach in South Carolina showed that trichloroethene concentrations obtained from water-filled diffusion samplers beneath a stream (142- 148 $\mu\text{g/L}$) were similar to those obtained from a small well point (131-147 $\mu\text{g/L}$) screened adjacent to the diffusion samplers.

Diffusion samplers installed in observation wells can be used to obtain representative water samples for chlorinated volatile organic compounds. The samplers consist of polyethylene bags containing deionized water placed adjacent to the water-bearing fracture or screened interval in the well. In saprolite and fractured-rock wells at a study area in South Carolina, the volatile organic compound concentrations in water samples obtained using the samplers without prior purging were similar to concentrations in water samples obtained from the respective wells using traditional purging and sampling approaches, such as a submersible electric pump, a bladder pump, and a bailer. The low cost associated with this approach makes it a viable option for monitoring large observation-well networks for volatile organic compounds.

Don Vroblesky, Ph.D., US Geological Survey, WRD, 720 Gracern Road, Columbia, SC 29210-7651; (803) 750-6115; vroblesk@usgs.gov