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Passive Diffusion Sampling for 1,4 Dioxane

Passive Diffusion Bag Samplers (PDBs) have been used worldwide to collect groundwater samples for Volatile Organic Compounds (VOCs) in groundwater since 1998. Lab and field case studies demonstrate that PDBs produce accurate sample concentrations and provide cost savings of 50 to 80% compared to low-flow and volume purge. PDBs also allow for discrete interval sampling and a reduced carbon footprint compared to pumping and bailing.

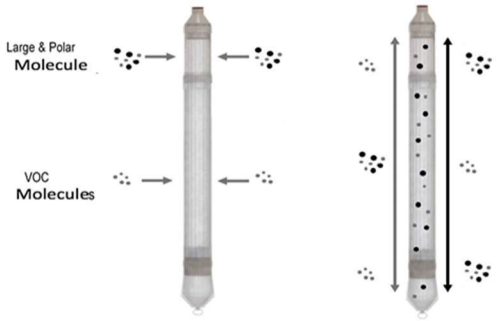
Expanding the List of Analytes Sampled By PDBs

Until now, the reliable and economical use of passive diffusion sampling has been limited to non-polar VOCs because large or polar molecules and highly soluble or miscible compounds, like 1,4 dioxane cannot pass through the hydrophobic polyethylene membrane and into the sampler. EON's Dual-Membrane Passive Diffusion (DMPDB) sampler operates under *the same principles as the well established PDB sampling,* using two semi-permeable membranes in a single sampler, to capture an expanded list of compounds.

What is the Principle?

Two separate semi-permeable membranes are aligned in series around a perforated tube and sealed to form a sample chamber. The sampler is filled with de-ionized water before use and lowered into the saturated well screen to intercept groundwater flow. When the surrounding groundwater contains molecules that are not in the sampler and that can pass through one of the membranes, a concentration gradient exists between the fluid inside the sampler and outside. The gradient drives the molecules in the groundwater to diffuse into the de-ionized water in the sampler until equilibration is reached. If the gradient is reversed, the molecules diffuse out of the sampler to maintain a constant dynamic equilibrium.

Why Two Membranes?



The upper membrane has large pores and is hydrophilic, facilitating diffusion of large and polar molecules into the sampler. The bottom membrane has smaller pores and is hydrophobic, allowing diffusion of non-polar VOCs from the surrounding groundwater into the sampler while retaining water for sampling. Molecules that enter the sampler through either membrane diffuse throughout the water inside the sampler until dynamic equilibrium is reached within the sampler and with the surrounding groundwater.

Benefits

- **Reduce cost of sample acquisition by 50-80%**
- **Sample Volume up to 650 ml per sampler**
- **Depth Discrete Interval Sampling**
- **Also Sample for VOCs, SVOCs, Metals, Inorganics & PFAS**
- **Virtually NO Investigation Derived Waste Water (IDW)**

Is the Dual Membrane PDB a Proven Sampling Method?
Yes. The Dual-Membrane PDB sampler (DMPDB) was developed by combining the functionality of passive sampling devices that were evaluated by the ITRC Passive Sampling Team in the mid 2000's and found effective for sampling a wide range of compounds. Each of the methods performed well but some were not user friendly or did not produce adequate sample volume or were too expensive to commercialize. The DMPDB enables sampling for a wide range of compounds in a simple and effective way using the passive diffusion technology developed by the U.S.G.S. Since its initial use by the USEPA, the DMPDB has undergone extensive laboratory bench testing, followed by field use, validating the DMPDB's effectiveness at producing samples that represent concentrations of contaminants in surrounding groundwater fluid.

A series of bench-tests were performed using the DMPDBs to demonstrate that the membrane selections and sampler configuration allows 1,4 Dioxane to diffuse into the sampler and produce a sample having concentrations equivalent to the surrounding water. An 8-inch diameter by 8-ftoot tall PVC sample chamber containing about 70 Liters of water was spiked with 1,4 Dioxane at a concentration of about 5 ug/L and then at 0.55 ug/L for the subsequent test. These concentrations are relevant because they represent the range of emerging regulatory thresholds. DMPDB samplers were installed, and the chamber sealed. The samplers were left in place for adequate time to allow for the diffusion process to come to equilibration and then Control samples were then taken from the fluid in the chamber surrounding the samplers. Next, the samplers were removed, and the contents discharged to laboratory bottles and sent to a certified lab for analysis using Method 522. The resulting data from the DMPDB samples shows strong correlation between the 1,4 Dioxane concentrations in the DMPDB and the concentrations from the Control samples representing the water in the chamber. The resulting data shows that the Dual Membrane Passive Diffusion Sampler, produces concentrations that accurately represent 1,4 Dioxane in the water surrounding the sampler.

The Dual-Membrane Passive Diffusion Sampler has been evaluated and adopted at private commercial sites, based on successful side by side comparisons with more costly sampling methods including low-flow pumping and bailing.

How Are They Deployed?
Like standard PDBs, the Dual-Membrane PDB sampler is lowered into the saturated screen on a re-usable weighted suspension tether, secured to the underside of the well cap. The DMPDBs are left in place for a minimum of two weeks. To save mobilization costs they may be left in place for an extended period and recovered at the next sampling event. Simply remove the samplers, discharge them to laboratory sample bottles and replace them with new DMPDBs for the next sampling event. Whenever the samplers are removed, they will represent the well concentrations of the previous few days.

Want to Know More about Passive Sampling?
Since EON first commercialized the PDB in 1998, we have been the leader in passive sampling. Contact EON by email: sales@eonpro.com or phone: 800-474-2490 / 770-978-9971

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