

A.1 Technology Name

Passive Diffusion Bag (PDB)

A.1.1 Source

Comparison of Diffusion- and Pumped- Sampling Methods to Monitor Volatile Organic Compounds in Ground Water, U.S. Geological Survey Scientific Investigations Report 2005-5010
Massachusetts Military Reservation, Cape Cod, Massachusetts, July 1999- December 2002 -
U.S. Geological Survey Scientific Investigations Report 2005-5010.

A.1.2 Summary

Media:	Groundwater
Study Type:	Comparison study
Technology:	Diffusion & Pumped Sampling Methods
Peer Reviewed:	No
Publication Date:	2005

A.1.3 Site Description

The study area for this report consisted of eighty-nine (89) monitoring wells at or near the Massachusetts Military Reservation (MMR) site located in Cape Cod, Massachusetts during two groundwater sampling event mobilizations in 1999 and 2002. The monitoring wells selected for the study were single-level monitoring wells with well screen length ranging from 1 to 10 feet, with most of the well screens being 5 feet.

The groundwater samples were collected for 36 volatile organic compounds (VOCs). The constituents of concern (COCs) were mostly chlorinated volatile organic compounds (CVOCs) and some petroleum VOCs. The CVOCs with most detections include Tetrachloroethene (PCE), Trichloroethene (TCE); 1,2-Dichloroethene (Trans. and Cis.) and Chloroform. Detections of acetone or MTBE were not included in the analysis because laboratory results have shown that diffusion samplers are not a reliable method to measure these two VOCs.

The scope of this study was to compare groundwater analytical results collected via conventional well pumped method ("pumped sample") and via passive diffusion bag sampler ("PDB sample").

A.1.4 Remedial Phase

Long Term Monitoring

A.1.5 Outcome

Concentration differences between the two sample methods were evaluated by using the relative percent difference (RPD) for the 36 above referenced COCs obtained by the two sampling methods to:

1. compare the RPD between results from replicate/duplicate samples obtained by each sampling method,
2. compare the results from repeated sampling of wells using both sampling methods, and
3. to determine if the RPD was related to characteristics external to the sampling methods.

The report concluded that there was no substantial difference between the utilities of diffusion sampling and pumped sampling as methods to detect the presence or absence of a particular VOC.

Visual inspection of the graphical display of individual VOC concentrations in the pumped sample plotted in relation to the diffusion-sample concentrations-particularly for PCE and TCE-showed a tendency for the diffusion sampler concentration to underpredict the pumped-sample concentration. The poor agreement between the pumped-sampler and diffusion-sampler concentrations of VOCs was not likely a result of variability inherent to the sampling methods, but rather external factor to the sampling methods, such as but not limited to the age of the well, well diameter, exposed screen, submergence of the sampler below water column, number of days PDB sampler deployed, hydraulic conductivity, anisotropic ratio, groundwater flow velocity, geochemical parameters at the time of collection and/or length of well screen.

The difference between the total VOC concentrations in the original and replicate pumped samples was small; the same observation was true for the original and replicate diffusion samples. Furthermore, the RPD between the pumped-sample and diffusion-sample concentrations for each well was greater than the RPD between the replicate samples for each method. The agreement between the sampling methods was repeatable between the first and second sampling rounds.

The evaluation showed better agreement between the methods in wells with 2-ft screens as compared to wells with 5-ft screens; however, it is not clear why this is the case. There is evidence from repeated sampling and from the results of diffusion samplers hung in series above the well screen to indicate that the flushing rate of water through the screen affects the degree of agreement between the methods.

Despite poor agreement between the concentrations obtained by the two methods at some wells, the degree to which the concentrations agree at a given well is repeatable. A one-time, well-by-well comparison between diffusion- and pumped-sampling methods could determine which wells are good candidates for use of diffusion samplers. For wells with good agreement, the diffusion-sampler method is a time-saving and cost-effective alternative to pumped-sampling methods in a long-term monitoring program.

A.1.6 References

Archfield, S.A., and LeBlanc, D.R., 2005, Comparison of Diffusion- and Pumped- Sampling Methods to Monitor Volatile Organic Compounds in Ground Water, Massachusetts Military Reservation, Cape Cod, Massachusetts, July 1999- December 2002: U.S. Geological Survey Scientific Investigations Report 2005-5010, 53 p.

