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ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM
VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**PASSIVE SOIL GAS SAMPLER**
APPLICATION:	**SUBSURFACE SOIL GAS SAMPLING**
TECHNOLOGY NAME:	**GORE-SORBER® SCREENING SURVEY PASSIVE SOIL GAS SAMPLING SYSTEM**
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ETV PROGRAM DESCRIPTION

The U.S. Environmental Protection Agency (EPA) created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative technologies through performance verification and information dissemination. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. The ETV Program is intended to assist and inform those involved in the design, distribution, permitting, and purchase of environmental technologies. This document summarizes the results of a demonstration of the W.L. Gore & Associates, Inc., GORE-SORBER® Screening Survey passive soil gas sampling system.

PROGRAM OPERATION

Under the ETV Program and with the full participation of the technology developer, the EPA evaluates the performance of innovative technologies by developing demonstration plans, conducting field tests, collecting and analyzing demonstration data, and preparing reports. The technologies are evaluated under rigorous quality assurance (QA) protocols to ensure that data of known and adequate quality are generated and that the demonstration results are defensible. The EPA's National Exposure Research Laboratory, which demonstrates field characterization and monitoring technologies, selected Tetra Tech EM Inc. as the verification organization to assist in field testing various soil and soil gas sampling technologies. This demonstration was conducted under EPA's Superfund Innovative Technology Evaluation Program.

DEMONSTRATION DESCRIPTION

In May and June 1997, the EPA conducted a field test of the GORE-SORBER® Screening Survey passive soil gas sampling system along with one other soil gas and four soil sampling technologies. This verification statement focuses on the GORE-SORBER® Screening Survey passive soil gas sampling system; similar statements have been prepared for each of the other technologies. The performance of the GORE-SORBER® Screening Survey passive soil gas sampling system was compared to the reference sampling method, active soil gas sampling (which provides a snapshot of the soil gas environment at the time the sample is collected). The comparison addressed three parameters: (1) volatile organic compound (VOC) detection and quantitation, (2) sample retrieval time, and (3) cost. Data quality indicators for precision, accuracy, representativeness, completeness, and comparability were also assessed against project-specific QA objectives to ensure the usefulness of the data.

The GORE-SORBER® Screening Survey passive soil gas sampling system was demonstrated at two sites: the Small Business Administration (SBA) site in Albert City, Iowa, and the Chemical Sales Company (CSC) site in Denver, Colorado. These sites were chosen because each site exhibited a wide range of VOC concentrations and a distinct soil type. The VOCs detected at the sites include vinyl chloride; cis-1,2-dichloroethene (cis-1,2-DCE); 1,1-dichloroethane (1,1-DCA); 1,1,1-trichloroethane (1,1,1-TCA); trichloroethene (TCE); and tetrachloroethene (PCE). The SBA site is composed primarily of clay soil, and the CSC site is composed primarily of medium- to fine-grained sandy soil. A complete description of the demonstration, including a data summary and discussion of results, is available in the report titled *Environmental Technology Verification Report: Passive Soil Gas Sampler, W.L. Gore & Associates, Inc., GORE-SORBER®* Screening Survey, EPA 600/R-98/095.

TECHNOLOGY DESCRIPTION

The GORE-SORBER® Screening Survey uses GORE-SORBER® modules to collect soil gas samples. The GORE-SORBER® module is a passive soil gas sampler that is designed to collect a broad range of VOCs and semivolatile organic compounds (SVOC), including halogenated compounds, petroleum hydrocarbons, and polynuclear aromatic hydrocarbons. A typical GORE-SORBER® module contains two or more passive collection units called sorbers. Each sorber contains an equal amount of sorbent materials (polymeric and carbonaceous resins). These granular adsorbent materials are used because of their affinity for a broad range of VOCs and SVOCs. The sorbers are sheathed in the bottom of a 4-foot-long, vapor-permeable retrieval cord. The cord and the sorbers are constructed of inert, hydrophobic, microporous GORE-TEX® expanded polytetrafluoroethene (ePTFE). The microporous structure of ePTFE allows vapors to move freely across the membrane and onto the sorbent material. This microporous structure also protects the granular adsorbents from physical contact with soil particulates and water. The GORE-SORBER® module is installed to a depth of 2 to 3 feet. A pilot hole is created using a slide hammer and tile probe or hand drill (in paved areas). The sampler is then manually inserted into the hole using push rods. The module is retrieved by hand and must be analyzed by the developer.

VERIFICATION OF PERFORMANCE

The demonstration data indicate the following performance characteristics for the GORE-SORBER® Screening Survey passive soil gas sampling system:

VOC Detection and Quantitation: The GORE-SORBER® Screening Survey detected the same compounds in each sample as the reference soil gas sampling method, as well as several VOCs that the reference method did not detect. This performance characteristic suggests that the GORE-SORBER® Screening Survey may detect VOCs that are at lower concentrations in the subsurface than the reference soil gas sampling method can detect. The results also indicate a general correlation between the GORE-SORBER® Screening Survey and reference method data. However, at high contaminant levels, the ratio between the mass of contaminant in soil gas detected using the GORE-SORBER® module and the concentration of contaminant in soil gas detected using the reference soil gas sampling method decreases, suggesting that sorbent saturation may have occurred. The GORE-SORBER® Screening Survey and reference method are field screening techniques that provide only an estimate of the actual concentration of contaminants in soil gas. Because the GORE-SORBER® Screening Survey and reference method use different techniques to collect soil gas samples, it is not expected that the two methods will provide the same response or that the data will be directly comparable. In addition, the GORE-SORBER® Screening Survey yields results in micrograms per sample and the reference soil gas sampling method reports results in nanograms per liter. Therefore, a statistical analysis of the data was not performed, and interpretation of the chemical concentration data for this demonstration is limited to qualitative observations.

Sample Retrieval Time: Installation of the GORE-SORBER® modules averaged 8.0 minutes per sampler at the SBA site and 7.4 minutes per sampler at the CSC site. For the demonstration, the modules were left in place for approximately 10 days. Collection of the modules required an average of 1.9 minutes per sampler at the SBA site and 2.4 minutes at the CSC site. Overall, installation and collection of 35 GORE-SORBER® modules at the SBA site required 346 minutes, an average of 9.9 minutes per sample and installation and collection of 28 GORE-SORBER® modules at the CSC site required 274 minutes, an average of 9.8 minutes per sample. The analysis and reporting by the technology developer required 14 to 18 days from the time samples were collected until the laboratory report was delivered. The reference soil gas method required 458 minutes to collect 35 samples at the SBA site, an average of 13.1 minutes per sample, and 183 minutes to collect 28 samples at the CSC site, an average of 6.5 minutes per sample. One day was required per site to analyze the samples and report the results. Based on the demonstration results, the average sample retrieval times for the GORE-SORBER® modules were quicker than the reference soil gas sampling method in the clay soils at the SBA site and slower than the reference sampling method in the sandy soils at the CSC site. The results also indicate that the sample retrieval time for the GORE-SORBER® modules may be less susceptible to variations in soil type than the sample collection times for the reference method. During sample collection using the reference active soil gas sampler, the clay soil at the SBA site caused the system to hold its vacuum at several sampling locations; therefore, soil gas was not completely drawn into the system for sampling. In these cases, the rod was withdrawn in additional 6-inch increments until the vacuum was broken and the system's pressure reached equilibrium with atmospheric pressure. The vacuum problem was not encountered in the sandy soil at the CSC site. A two-person sampling crew retrieved soil gas samples using the GORE-SORBER® Screening Survey at both the SBA and CSC sites, and a three-person sampling and analysis crew collected and analyzed the soil gas samples using the reference soil gas sampling method at both sites.

Cost: Based on the demonstration results, the GORE-SORBER® Screening Survey cost $125 to $225 per sample plus equipment costs of $25 to $85 per day and mobilization/demobilization costs of $200 to $600 per day. Operating costs for the GORE-SORBER® Screening Survey ranged from $810 to $1,540 at both the clay soil site and the sandy soil site. For this demonstration, the active soil gas sampling method was procured at a lump sum of $4,700 per site for the collection and analysis of 40 soil gas samples at each site. Oversight costs for the active soil gas sampling method ranged from $680 to $1,260 at the clay soil site and $480 to $910 at the sandy soil site. A site-specific cost and performance analysis is recommended before selecting a subsurface soil gas sampling method.

A qualitative performance assessment of the GORE-SORBER® Screening Survey indicated that (1) all 63 modules installed at the SBA and CSC sites were retrieved without sample loss, resulting in 100 percent completeness;(2) the sampler is easy to use and requires minimal training (a 10-minute training video is available from the developer); (3) logistical requirements for the GORE-SORBER® Screening Survey require that the samplers be installed using a manual push tool, left in place for several days, retrieved by hand, and sent to the developer for analysis; and (4) sample handling in the field requires that sorbent be properly containerized and shipped to the developer. Other factors that may affect the performance range of the GORE-SORBER® Screening Survey but that were not evaluated during the demonstration are sampling depth, time allowed for sampling, type and amount of sorbent material placed in the GORE-SORBER® module, and ability of vapors to move across the module membrane.

The demonstration results indicate that the GORE-SORBER® Screening Survey can provide useful, cost-effective data for environmental problem-solving. The GORE-SORBER® modules successfully collected soil gas samples in clay and sandy soils. The sampler provided positive identification of target compounds and may detect lower concentrations of VOCs in the soil gas than can the reference soil gas sampling method. Based on the results of this demonstration, there appears to be a general correlation between the GORE-SORBER® Screening Survey and reference method data. However, at higher contaminant levels, the ratio between the mass of contaminant detected in the soil gas using the GORE-SORBER® module and the concentration of contaminant detected using the reference method decreases. As with any technology selected, the user must determine what is appropriate for the application and the project data quality objectives.

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