THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

Sandia National Laboratories

ETV JOINT VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**GROUNDWATER SAMPLING TECHNOLOGIES**
APPLICATION:	**VOC-CONTAMINATED WATER SAMPLING**
TECHNOLOGY NAME:	**Multiprobe 100**
COMPANY:	**Burge Environmental**
ADDRESS:	**6100 South Maple Ave. Suite 114 Tempe, AZ 85283**
	PHONE: (602) 968-5141 FAX: (602) 894-1675
WEBSITE:	**www.burgenv.com**
EMAIL:	burgenv@primenet.com

The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification Program (ETV) to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations and stakeholder groups consisting of regulators, buyers, and vendor organizations, with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Site Characterization and Monitoring Technologies Pilot, one of 12 technology areas under ETV, is administered by EPA's National Exposure Research Laboratory. Sandia National Laboratories, a Department of Energy laboratory, is one of the verification testing organizations within the ETV Site Characterization and Monitoring Pilot. Sandia collaborated with personnel from the US Geological Survey to conduct a verification study of groundwater sampling technologies. This verification statement provides a summary of the results from a verification test of the Multiprobe 100 sampler manufactured by Burge Environmental.

DEMONSTRATION DESCRIPTION

In August 1999, the performance of six groundwater sampling devices was evaluated at the US Geological Survey Hydrological Instrumentation Facility at the NASA Stennis Space Center in southwestern Mississippi. Each technology was independently evaluated in order to assess its performance in the collection of volatile organic compound- (VOC) contaminated water.

The verification test design incorporated the use of a 5-inch diameter,100-foot standpipe at the USGS facility. The standpipe, serving as an "above-ground" well, was filled with tap water spiked with various concentration levels of six target volatile organic compounds. The target compounds (1,2-dichloroethane, 1,1-dichloroethene, trichloroethene, benzene, 1,1,2-trichloroethane, and tetrachloroethene) were chosen to represent the range of VOC volatility likely to be encountered in normal sampler use. Water sampling ports along the exterior of the standpipe were used to collect reference samples at the same time that groundwater sampling technologies collected samples from the interior of the pipe. A total of seven trials were carried out at the standpipe. The trials included the collection of low (~20 µg/L) and high (~200 µg/L) concentrations of the six target VOC compounds in water at sampler depths ranging from 17 to 91 feet. A blank sampling trial was also included in the test matrix.

The standpipe trials were supplemented with additional trials at groundwater monitoring wells in the vicinity of sites with VOC-contaminated groundwater at the NASA Stennis facility. The sampling devices were deployed in a number of 2-inch and 4-inch wells, along with co-located submersible electric gear pumps as reference samplers. The principal contaminant at the onsite monitoring wells was trichloroethene. The onsite monitoring provided an opportunity to observe the operation of the sampling system under typical field-use conditions.

All technology and reference samples were analyzed by two identical field-portable gas chromatograph-mass spectrometer (GC/MS) systems that were located at the test site during the verification tests. The GC/MS analytical method used was a variation of EPA Method 8260 purge-and-trap GC/MS, incorporating a headspace sampling system in lieu of a purge and trap unit. The overall performance of the groundwater sampling technologies was assessed by evaluating sampler precision and comparability with reference samples. Other logistical aspects of field deployment and potential applications of the technology were also considered in the evaluation.

Details of the demonstration, including an evaluation of the sampler's performance, may be found in the report entitled *Environmental Technology Verification Report: Burge Environmental Inc., Multiprobe 100,* EPA/600/R-00/074.

TECHNOLOGY DESCRIPTION

The Multiprobe 100 is a discrete, multi-level sampler that is designed for permanent deployment in a well. The sampler is designed for use with a complementary automated wellhead analyzer for TCE called the Optrode. Only the sampling module was evaluated in this test. Optrode performance was not evaluated in this demonstration.

The Multiprobe 100 consists of two units with tubing and wiring interconnections. A upper receiving module which is deployed at the wellhead on top of the well is 18 inches long, 3.25 inches in diameter, and weighs 3 pounds. The lower sampling module, which is inserted into the water column inside the well, is 12 inches long, 3.25 inches in diameter and also weighs 3 pounds. The system is constructed of Teflon, borosilicate glass, stainless steel and Delrin®, a solvent-resistant, acetal homopolymer resin. Electrical solenoid valves are used to select the sampling level and control gas flow to the sampler. Water level sensors in the water chambers of both modules are used to trigger valve changes during the sampling process. A small, battery-operated microprocessor controller is used to control the valves used during the sampling process.

The lower sampling module is filled with water from the selected sampling level by hydrostatic pressure. The water sample is then pushed up to the upper receiving module by pressurizing the sampling chamber headspace with nitrogen gas. Samples can be manually dispensed into analysis vials from the upper receiving module, however, the system is primarily intended for interconnection with automated analyzers, such as the Optrode, which would also be positioned at the wellhead.

The system also has the ability to purge volatile organic compounds from water *in situ* with subsequent analysis by sensors, such as the Optrode, that are positioned in the headspace or at the wellhead. Following the purge, the vapors can also be transported via tubing to the surface for collection and analysis. The *in situ* purge capability of the sampler was not tested in this investigation.

VERIFICATION OF PERFORMANCE

The following performance characteristics of the Multiprobe 100 groundwater sampling system were observed:

Precision: The precision of the sampler was determined through the collection of a series of replicate samples from two standpipe trials using low (~20 μg/L) and high (~200 μg/L) VOC concentrations at 17, 35, 53 and 91-foot depths. Each trial included 6 target VOCs at each of the sampling depths, resulting in a total of 24 cases per trial. Multiprobe 100 precision, represented by the relative standard deviation, for all compounds at all concentrations and sampling depths evaluated in this study ranged from 3 to 21% with a median value of 9.4 %. In 27 of the 48 cases, the Multiprobe 100 was less precise than the reference sample set. The F-ratio test was used to assess whether precision differences between Multiprobe 100 and reference samples were statistically significant. Test results showed that precision differences between the Multiprobe 100 and reference samples were statistically insignificant at the 95% confidence level in 46 of the 48 test cases.

Comparability with a Reference: Multiprobe 100 sampler results from the standpipe trials were compared with results obtained from reference samples that were collected at the same time. Both Multiprobe 100 and reference samples were analyzed by the same method using the same GC/MS system. Sampler comparability is expressed as percent difference relative to the reference data. Sampler differences for all target VOC compounds at all concentrations and sampler depths in this study ranged from -30 to 15%, with a median percent difference of -5%. The t-test for sample means was used to assess whether the observed differences between Multiprobe 100 and reference samplers were statistically significant. These tests revealed that in 31 of 48 trials, differences were statistically indistinguishable from 0% at the 95% confidence level. Of the remaining 17 cases that were statistically different from 0%, 16 showed a negative Multiprobe 100 sampler bias. Statistically significant negative sampler bias ranged from – 10 to – 30%.

Versatility: Sampler versatility is the consistency with which it performed with various target compounds, concentration levels, and sampling depths. In terms of precision, Multiprobe 100 performance was generally consistent at the range of concentrations and collection depths evaluated in this study. The Multiprobe 100 showed a trend toward negative bias for 11DCE and TCE and the sampler showed consistently negative bias for PCE at all concentrations and sampler depths. As a result of its physical size, the Multiprobe 100 cannot be installed in wells with diameters less than 4 inches. In light of these considerations, the Multiprobe 100 sampler in its aqueous sampling mode is judged to have limited versatility.

Logistical Requirements: The Multiprobe 100 is designed for permanent installation in 4-inch or larger wells. The installation would require either custom installation by Burge Environmental personnel or user installation following approximately two days of training. Although the system is optimized for automated operation, it can also be used in a manual mode. The system is also capable of being removed from one installation for redeployment in a second well however several hours of disassembly and re-assembly time would be required. The system also requires a source of compressed nitrogen at the wellhead.

Overall Evaluation: The results of this verification test show that the Multiprobe 100 multi-level sampler can be used to collect VOC-contaminated water samples that are generally statistically comparable to reference samples. Sampler recoveries for PCE in the aqueous sampling and transfer mode were consistently low when compared to reference samples. Further investigation of sampler performance for this compound may be required. The Multiprobe 100 is a component of an overall automated sampling and analysis system. Only the sampler module was evaluated in this test. A complete system evaluation would be warranted prior its deployment in long term automated monitoring applications.

As with any technology selection, the user must determine if this technology is appropriate for the application and the project data quality objectives. For more information on this and other verified technologies visit the ETV web site at http://www.epa.gov/etv.

Gary J. Foley, Ph.D	Samuel G. Varnado
Director	Director
National Exposure Research Laboratory	Energy and Critical Infrastructure Center
Office of Research and Development	Sandia National Laboratories