THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

ETV

U.S. Environmental Protection Agency

Sandia National Laboratories

ETV JOINT VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**GROUNDWATER SAMPLING TECHNOLOGIES**
APPLICATION:	**VOC-CONTAMINATED WATER SAMPLING**
TECHNOLOGY NAME:	**Well Wizard Dedicated Sampling System — Models T1200M and T1250**
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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 (USGS) to conduct a verification study of groundwater sampling technologies. This verification statement provides a summary of the results from a verification test of the Well Wizard bladder pumps and pneumatic controller manufactured by QED Environmental Systems Inc.

DEMONSTRATION DESCRIPTION

In August 1999, the performance of six groundwater sampling devices was evaluated at the US Geological Survey Hydrological Instrumentation Facility at the National Aeronautics and Space Administration (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 "aboveground" 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 VOCs in water at sampler depths ranging from 17 to 91 feet. A blank sampling trial and an optional "clean-through-dirty" test were also included in the test matrix. The "clean-through-dirty" test was included to investigate the potential of contaminant carryover as a sampler is lowered through a "dirty" (high VOC concentration) layer of water in order to sample an underlying "clean" (low VOC concentration) layer. The test was optional for samplers such as the Well Wizard dedicated sampling system, which is designed for permanent deployment in a single monitoring well.

The standpipe trials were supplemented with additional trials at groundwater monitoring wells in the vicinity of 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 colocated 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: QED Environmental Systems Inc. Well Wizard Dedicated Sampling System*, EPA/600/R-00/062.

TECHNOLOGY DESCRIPTION

The Well Wizard is a bladder pump consisting of an internal flexible bladder that is positioned within a rigid stainless steel pump body. The inner bladder is equipped with one-way inlet and outlet valves and passively fills with water when the pump is at depth in the well as a result of the hydrostatic pressure exerted by the surrounding water column. Following the fill cycle, compressed air or nitrogen from a cylinder or compressor at the wellhead is driven down to the pump through tubing to compress the bladder, thus driving the water sample up to the surface through a second tubing line. The pumping sequence consists of repeated fill–compress cycles, using a pneumatic controller positioned at the wellhead. The controller is used to vary the duration and frequency of the fill–compress cycles in order to deliver the desired sample flow rate at the wellhead. The bladder design offers the advantage of minimizing sample turbulence, which can result in loss of VOCs in the sample, as well as eliminating contact of the water sample with the compressed air or nitrogen used to lift the sample to the surface.

QED Environmental offers a complete line of bladder pumps manufactured with various materials. Two pumps tested during this evaluation were the Model T1220M and the T1250. These two pumps were essentially the same in design and construction materials with differences only in pump length—the Model 1220 was 1.04 m in length and the 1250 was 0.38 m in length. Both pumps use polytetrafluoroethylene (Teflon) for the bladder material and 316 stainless steel for the pump body, fittings, and intake screen. The external diameter of both pumps was 3.8 cm (1.5 inches). The pump intake stainless steel screen mesh size was 0.25 mm (0.01 inch). Both pumps have a maximum lift capacity of 90 m (300 feet), and flow rates are adjustable from less than 100 mL/min to over 5 L/min, depending on pump lift.

The QED Model 400 controller is a microprocessor-based controller and was used to control the flow of compressed nitrogen, obtained from a cylinder at the wellhead, to the bladder pump. The controller has a weatherproof keypad and a liquid crystal display and is packaged in a durable case that can be hand carried. The controller has overall dimensions of 18 × 14 × 7.5 inches and a weight of 17 pounds. Drive gas for the bladder pump can be delivered from compressed gas cylinders or from a field-portable gasoline- or electric-powered compressor.

Costs for the two bladder pumps tested range from $525 to $650 each and the controller is priced at $2,595. Teflon-lined polyethylene tubing is also a requirement for most VOC sampling applications and is priced at $3.30 per foot.

The Model T1220M and T1250 differ only in size. The pumps were used interchangeably in the study and their performance results are combined. Hereafter, the two pump models are simply referred to as the Well Wizard sampler.

VERIFICATION OF PERFORMANCE

The following performance characteristics of the Well Wizard dedicated sampling system were observed:

Precision: The precision of the sampler was determined through the collection of a series of replicate samples from 4 standpipe trials using low (~20 µg/L) and high (~200 µg/L) VOC concentrations at 17-foot and 91-foot collection depths. Each trial included 6 target VOCs for a total of 24 cases. Well Wizard sampler precision, represented by the relative standard deviation, for all compounds at all concentrations and sampling depths evaluated in this study, ranged from 3.9 to 19.7%, with a median value of 7.7%. In 14 cases the relative standard deviation of the Well Wizard samples was greater than the reference, with Well Wizard precision less than or equal to reference sample precision in the other 10 cases. The F-ratio test was used to assess whether the observed precision differences were statistically significant. Test results showed that precision differences between Well Wizard and reference samples were statistically insignificant at the 95% confidence level in 22 of the 24 cases.

Comparability with a Reference: Well Wizard results from the standpipe trials were compared with results obtained from reference samples collected at the same time. Both Well Wizard and reference samples were analyzed by the same analytical method using the same GC/MS system. Sampler comparability is expressed as percent difference relative to the reference data. Sampler differences for all target VOCs at all concentrations and sampler depths in this study ranged from −17 to 20%, with a median difference of 1%. The t-test for two sample means was used to assess whether the differences between Well Wizard and reference sample results were statistically significant. These tests showed that in 22 of 24 trials, differences were statistically indistinguishable from 0% at the 95% confidence level. Statistically significant Well Wizard negative bias did not exceed 17%.

Versatility: Sampler versatility is the consistency with which the sampler performed over the range of target compound volatility, concentration level, and sampling depth. Well Wizard performance did not vary with changes in compound, concentration, or sampler depth. Thus, the Well Wizard is regarded as a widely versatile sampling device and applicable for sampling the types of VOCs likely to be encountered under actual field conditions.

Logistical Requirements: The sampler can be deployed and operated in the field by one person. A half-day of training is generally adequate to become proficient in the use of the system. The system requires a source of compressed air or nitrogen at the wellhead, such as a compressed gas cylinder or a gas- or electric-powered compressor. The bladder pumps are designed for dedicated use in a single monitoring well and are not intended for portable use.

Overall Evaluation: The results of this verification test show that the Well Wizard bladder pump and associated pneumatic controller can be used to collect VOC-contaminated water samples that are statistically comparable to reference samples when analyzed with a common analytical method. The system is designed for use in well-sampling programs that incorporate low-volume purge methodologies.

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.

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