UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, D.C. 20460

ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM
VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**FIELD-PORTABLE GAS CHROMATOGRAPH**
APPLICATION:	**MEASUREMENT OF CHLORINATED VOLATILE ORGANIC COMPOUNDS IN WATER**
TECHNOLOGY NAME:	**Scentograph Plus II**
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PROGRAM DESCRIPTION

The U.S. Environmental Protection Agency (EPA) created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative environmental 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.

Under this program, in partnership with recognized testing organizations, 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 the demonstration results, and preparing reports. The testing is 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 EPA National Exposure Research Laboratory, in cooperation with Sandia National Laboratories, the testing organization, evaluated field-portable systems for monitoring chlorinated volatile organic compounds (VOCs) in water. This verification statement provides a summary of the demonstration and results for the Sentex Systems, Inc. Scentograph Plus II, field-portable gas chromatograph (GC).

DEMONSTRATION DESCRIPTION

The field demonstration of the Scentograph Plus II portable GC was held in September 1997. The demonstration was designed to assess the ability of the instrument to detect and measure chlorinated VOCs in groundwater at two contaminated sites: the Department of Energy's Savannah River Site, near Aiken, South Carolina, and the McClellan Air Force Base, near Sacramento, California. Groundwater samples from each site were supplemented with performance evaluation (PE) samples of known composition. Both sample types were used to assess instrument accuracy, precision, sample throughput, and comparability to reference laboratory results. The primary target compounds at the Savannah River Site were trichloroethene and tetrachloroethene. At McClellan Air Force Base, the target compounds were trichloroethene, tetrachloroethene, 1,2-dichloroethane, 1,1,2-trichloroethane, 1,2-

dichloropropane, and *trans*-1,3-dichloropropene. These sites were chosen because they contain varied concentrations of chlorinated VOCs and exhibit different climatic and geological conditions. The conditions at these sites are typical, but not inclusive, of those under which this technology would be expected to operate. A complete description of the demonstration, including a data summary and discussion of results, may be found in the report entitled *Environmental Technology Verification Report, Field-Portable Gas Chromatograph, Sentex Systems, Inc., Scentograph Plus II*. (EPA/600/R-98/145).

TECHNOLOGY DESCRIPTION

Gas chromatography with electron capture detection is a proven analytical technology that has been used in environmental laboratories for many years. The gas chromatographic column separates the sample into individual components. The electron capture detector measures a change in electron current from a sealed radioactive source as compounds exit the chromatographic column, move through the detector, and capture electrons. The electron capture detector is particularly sensitive to chlorinated compounds. Compound identification is achieved by matching the column retention time of sample components, run under controlled temperature conditions, to those of standard mixtures run under similar conditions. Quantitation is achieved by comparing the detector response intensity of sample component and standard. A GC offers some potential for identification of unknown components in a mixture; however, a confirmational analysis by an alternative method is often advisable. Portable GC is a versatile technique that can be used to provide rapid screening data or routine monitoring of groundwater samples. In many GC systems, the instrument configuration can also be quickly changed to accommodate different sample matrices such as soil, soil gas, water, or air. As with all field analytical studies, it may be necessary to send a portion of the samples to an independent laboratory for confirmatory analyses.

The Scentograph Plus II consists of three modules: a purge-and-trap unit, a GC, and a notebook computer for instrument control and data acquisition. The entire system weighs about 80 pounds and is about the size of a large suitcase. The units can be easily transported and operated in the rear compartment of a minivan or station wagon. Instrument detection levels for most chlorinated VOCs in water range from 0.1 to 50 µg/L. Sample processing and analysis can be accomplished by a chemical technician; however, instrument method development, instrument calibration, and data processing require a higher level of operator experience and training. The recommended training interval for routine sample processing is 1 day for a field technician with limited GC experience. At the time of the demonstration, the baseline cost of the Scentograph Plus II was $35,000. Operational costs, which take into account consumable supplies, are on the order of $25 per 8-hour day.

VERIFICATION OF PERFORMANCE

The following performance characteristics of the Scentograph Plus II were observed:

Sample Throughput: Throughput was about two samples per hour. This rate includes the periodic analysis of blanks and calibration check samples. The sample throughput rate is influenced by the complexity of the sample, with less complex samples yielding higher throughput rates.

Completeness: The Scentograph Plus II reported results for all 165 PE evaluation and groundwater samples provided for analysis at the two demonstration sites.

Analytical Versatility: The Scentograph Plus II was calibrated for and detected 59% (19 of 32) of the PE sample VOC compounds in the PE samples provided for analysis at the demonstration. Three pairs of coeluting compounds were encountered with the GC methods used during this demonstration. For the groundwater contaminant compounds for which it was calibrated, the Scentograph Plus II detected 35 of the 62 compounds reported by the reference laboratory at concentration levels in excess of 1 µg/L. A total of 68 compounds were detected by the reference laboratory in all groundwater samples.

Precision: Precision was determined by analyzing sets of four replicate samples from a variety of PE mixtures containing known concentrations of chlorinated VOCs. The results are reported in terms of relative standard deviations (RSD). The RSDs compiled for all reported compounds from both sites had a median value of 8% and a

95th percentile value of 32%. By comparison, the compiled RSDs from the reference laboratory had a median value of 7% and a 95th percentile value of 25%. The ranges of Scentograph Plus II RSD values for specific target compounds were as follows: trichloroethene, 0 to 17%; tetrachloroethene, 3 to 28%; 1,2-dichloropropane, 5 to 12%; 1,1,2-trichloroethane, 6 to 24%; *trans*-1,3-dichloropropene, 4 to 29%; and 1,2-dichloroethane, 6 to 36%.

Accuracy: Instrument accuracy was evaluated by comparing Scentograph Plus II results with the known concentrations of chlorinated VOCs in PE mixtures. Absolute percent difference (APD) values from both sites were calculated for all reported compounds in the PE mixtures. The APDs from both sites had a median value of 10% and a 95th percentile value of 38%. By comparison, the compiled APDs from the reference laboratory had a median value of 7% and a 95th percentile value of 24%. The ranges of Scentograph Plus II APD values for target compounds were as follows: trichloroethene, 1 to 24%; tetrachloroethene, 0 to 15%; 1,2-dichloropropane, 2 to 22%; 1,1,2-trichloroethane, 3 to 16%; *trans*-1,3-dichloropropene, 0 to 24%; and 1,2-dichloroethane, 3 to 78%.

Comparability: A comparison of Scentograph Plus II and reference laboratory data was based on 33 groundwater samples analyzed at each site. The correlation coefficient (*r*) for all compounds detected by both the Scentograph Plus II and laboratory at or below the 100 µg/L concentration level was 0.974 at Savannah River and 0.959 at McClellan. The *r* values for compounds detected at concentration levels in excess of 100 µg/L were 0.907 for Savannah River and 0.997 for McClellan. These correlation coefficients reveal a highly linear relationship between Scentograph Plus II and laboratory data. The median APD between groundwater compounds mutually detected by the Scentograph Plus II and the reference laboratory was 12% with a 95th percentile value of 194%.

Deployment: The system was ready to analyze samples within 60 minutes of arrival at the site. At both sites, the instrument was transported in a minivan and operated from its folded middle seat. The instrument was powered by line ac or from a small dc-to-ac inverter connected to the vehicle's battery.

The results of the demonstration show that the Sentex Systems, Inc., Scentograph Plus II field-portable GC with electron capture detector can provide useful, cost-effective data for environmental site screening and routine monitoring. This instrument could be employed in a variety of applications, ranging from producing rapid analytical results in screening investigations, to producing accurate and precise data that are directly comparable with that obtained from an off-site laboratory. These data could be used to develop risk assessment information, support a remediation process, or fulfill monitoring requirements. In the selection of a technology for deployment at a site, the user must determine what is appropriate through consideration of instrument performance and the project's data quality objectives.

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