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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
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ETV

ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM
VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**SOIL SAMPLER**
APPLICATION:	**SUBSURFACE SOIL SAMPLING**
TECHNOLOGY NAME:	**AMS™ DUAL TUBE LINER SAMPLER**
COMPANY:	**ART'S MANUFACTURING AND SUPPLY**
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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 AMS™ Dual Tube Liner Sampler.

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 the EPA's Superfund Innovative Technology Evaluation Program.

DEMONSTRATION DESCRIPTION

In May and June 1997, the EPA conducted a field test of the AMS™ Dual Tube Liner Sampler along with three other soil and two soil gas sampling technologies. This verification statement focuses on the AMS™ Dual Tube Liner Sampler; similar statements have been prepared for each of the other technologies. The performance of the Dual Tube Liner Sampler was compared to a reference subsurface soil sampling method (hollow-stem auger drilling and split-spoon sampling) in terms of the following parameters: (1) sample recovery, (2) volatile organic compound (VOC) concentrations in recovered samples, (3) sample integrity, (4) reliability and throughput, and (5) 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 Dual Tube Liner Sampler 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 of the wide range of VOC concentrations detected at the sites and because each has a distinct soil type. The VOCs

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detected at the sites include cis-1,2-dichloroethene (cis-1,2-DCE); 1,1,1-trichloroethane (1,1,1-TCA); trichloroethene (TCE); and tetrachloroethene (PCE). Soils at the SBA site are composed primarily of clay, and soils at the CSC site are composed primarily of medium- to fine-grained sand. A complete description of the demonstration, including a data summary and discussion of results, is available in a report titled *Environmental Technology Verification Report: Soil Sampler, Art's Manufacturing and Supply, AMS™ Dual Tube Liner Sampler*, EPA 600/R-98/093.

TECHNOLOGY DESCRIPTION

The Dual Tube Liner Sampler was designed to collect subsurface soil samples by using direct-push platform technology. The sampler assembly is constructed of two steel tubes, or "extensions," of differing diameters designed so that the smaller of the two tubes fits within the larger. The outer extension is available in two diameters, 2-1/8-inch outside diameter (o.d.) and 1-3/4-inch o.d., and is equipped with a metal drive tip at the lower end. The outer extension is threaded at the upper end to facilitate additional metal extensions with increasing depth and the addition of a drive head adaptor to the top of the tool string. The inner extension is also available in two diameters, 1-3/4-inch o.d. and 1-1/8-inch o.d., to match the selected outer extension diameter. The lower end of the inner extension is threaded with a plastic grabber to facilitate the attachment of a polybutyrate liner during sample collection or a solid point metal inner drive tip during sampler advancement. The components of the sampler are assembled such that the outer extension serves as a temporary casing so that continuous or discrete soil samples can be collected using the inner extension liner and drive tip assemblies.

VERIFICATION OF PERFORMANCE

The demonstration data indicate the following performance characteristics for the AMS™ Dual Tube Liner Sampler:

Sample Recovery: For the purposes of this demonstration, sample recovery was defined as the ratio of the length of recovered sample to the length of sampler advancement. Sample recoveries from 42 samples collected at the SBA site ranged from 42 to 100 percent, with an average sample recovery of 91 percent. Sample recoveries from 42 samples collected at the CSC site ranged from 46 to 88 percent, with an average sample recovery of 70 percent. Using the reference method, sample recoveries from 41 samples collected at the SBA site ranged from 40 to 100 percent, with an average recovery of 88 percent. Sample recoveries from the 42 samples collected at the CSC site ranged from 53 to 100 percent, with an average recovery of 87 percent. A comparison of recovery data from the Dual Tube Liner Sampler and the reference sampler indicates that the Dual Tube Liner Sampler achieved higher recoveries in the clay soil at the SBA site and lower sample recoveries in the sandy soil at the CSC site relative to the sample recoveries achieved by the reference sampling method.

Volatile Organic Compound Concentrations: Soil samples collected using the Dual Tube Liner Sampler and the reference sampling method at six sampling depths in nine grids (five at the SBA site and four at the CSC site) were analyzed for VOCs. For 21 of the 25 Dual Tube Liner Sampler and reference sampling method pairs (12 at the SBA site and 13 at the CSC site), a statistical analysis using the Mann-Whitney test indicated no significant statistical difference at the 95 percent confidence level between the VOC concentrations in samples collected with the Dual Tube Liner Sampler and those collected with the reference sampling method. Of the sample pairs where a statistically significant difference was identified, one was at the SBA site and three were at the CSC site. Analysis of the CSC site data, using the sign test, indicated no statistical difference between data obtained by the Dual Tube Liner Sampler and the reference method at the CSC and SBA sites.

Sample Integrity: A total of 12 integrity samples were collected with both sampling methods at each site to determine if potting soil in sampler interiors became contaminated after it was advanced through a zone of high VOC concentrations. For the Dual Tube Liner Sampler, VOCs were detected in only one of the 12 integrity samples. The sample was collected at the CSC site. The VOC detected in the potting soil at the CSC site was cis-1,2-DCE at a concentration of 6.07 micrograms per kilogram (μg/kg). These results indicate that the integrity of a lined chamber in the Dual Tube Liner Sampler is generally well preserved when the sampler is advanced through highly contaminated soils. Results of sample integrity tests for the reference sampling method indicate no contamination in the potting soil after advancement through a zone of high VOC concentrations. Because potting soil has an organic carbon content many times greater than typical soils, the integrity tests represent a worst-case scenario for VOC absorbance and may not be representative of cross-contamination under normal field conditions.

Reliability and Throughput: At the SBA site, the Dual Tube Liner Sampler collected a sample from the desired depth on the initial attempt 98 percent of the time. Sample collection in the initial push was also achieved 98 percent of the time at the CSC site. At the SBA site, the Dual Tube Liner Sampler did not collect a sample in the initial push in only one instance. The sample liner was lost during that attempt due to overfilling. The sample was retrieved on the second attempt, resulting in 100 percent sample completeness. At the CSC site, the Dual Tube Liner Sampler did not collect a sample in the initial push in only one instance. The sample was lost when unconsolidated sand fell from the bottom of the liner. The problem was corrected by fashioning retaining baskets out of liner caps and the sample was collected on the subsequent push, resulting in 100 percent sample completeness. One sample was collected in the saturated zone at Grid 5 at the CSC site in one attempt, resulting in an initial sampling success rate of 100 percent. The developer did not attempt to collect additional samples from the 40-foot interval due to excessive friction on the outer extension. For the reference sampling method, the initial sampling success rates at the SBA and CSC sites were 90 and 95 percent, respectively. Success rates for the reference sampling method were less than 100 percent due to (1) drilling beyond the target sampling depth, (2) insufficient sample recovery, or (3) auger refusal. The average sample retrieval time for the Dual Tube Liner Sampler to set up on a sampling point, collect the specified sample, grout the hole, decontaminate the sampler, and move to a new sampling location was 16.4 minutes per sample at the SBA site and 10.9 minutes per sample at the CSC site. For the reference sampling method, the average sample retrieval time at the SBA and CSC sites were 26 and 8.4 minutes per sample, respectively. Two people collected soil samples with the Dual Tube Soil Sampler at both the SBA and CSC sites, and a three-person sampling crew collected soil samples using the reference sampling method at both sites. Additional personnel were present at both sites to observe and assist with demonstration sampling, as necessary.

Cost: Based on the demonstration results and information provided by the vendor, the Dual Tube Liner Sampler can be purchased for $1,890 and the PowerProbe 9600 direct push rig rented for $1,800 per week. Operating costs for the Dual Tube Liner Sampler ranged from $2,280 to $4,260 at the clay soil site and $1,830 to $3,060 at the sandy soil site. For this demonstration, reference sampling was procured at a lump sum of $13,400 for the clay soil site and $7,700 for the sandy soil site. Oversight costs for the reference sampling ranged from $4,230 to $6,510 at the clay soil site and $1,230 to $2,060 at the sandy soil site. A site-specific cost analysis is recommended before selecting a subsurface soil sampling method.

A qualitative performance assessment of the AMS™ Dual Tube Liner Sampler indicated that (1) the sampler is easy to use and requires less than 1 hour of training to operate; (2) logistical requirements are similar to those of the reference sampling method; (3) sample handling is similar to the reference method; (4) the performance range is primarily a function of the advancement platform; and (5) no drill cuttings are generated when using the Dual Tube Liner Sampler with a push platform.

The demonstration results indicate that the Dual Tube Liner Sampler can provide useful, cost-effective samples for environmental problem-solving. However, in some cases, VOC data collected using the Dual Tube Liner Sampler may be statistically different from VOC data collected using the reference sampling method. As with any technology selection, the user must determine what is appropriate for the application and project data quality objectives.

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