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

ETV✓

ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM
VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**SOIL SAMPLER**
APPLICATION:	**SUBSURFACE SOIL SAMPLING**
TECHNOLOGY NAME:	**SIMULPROBE® CORE BARREL SAMPLER**
COMPANY:	**SIMULPROBE® TECHNOLOGIES, INC.**
ADDRESS:	**354 BEL MARIN KEYS BOULEVARD, SUITE F NOVATO, CALIFORNIA 94949**
PHONE:	**(714) 374-9969**

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 SimulProbe® Core Barrel 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 SimulProbe® Core Barrel Sampler along with three other soil and two soil gas sampling technologies. This verification statement focuses on the SimulProbe® Core Barrel Sampler; similar statements have been prepared for each of the other technologies. The performance of the Core Barrel 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 Core Barrel 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 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). 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: Soil Sampler, SimulProbe® Technologies, Inc., SimulProbe® Core Barrel Sampler*, EPA 600/R-98/094.

TECHNOLOGY DESCRIPTION

The Core Barrel Sampler was designed to collect subsurface soil samples and may be advanced by using direct-push or drilling platforms. The sampler is constructed of steel and consists of a split core barrel (similar to a split-spoon sampler), a drive shoe at the bottom of the unit, and a core barrel head at the top of the unit. The sampler has a uniform 2-inch outer diameter and is 27 inches long. It is capable of recovering a discrete sample in the form of a 1.25-inch-diameter and 27-inch-long soil core. Multiple 5.25-inch-long stainless-steel liners or a single full-length plastic liner can be used inside the sampler to contain the soil core. The drive shoe component of the sampler is equipped with a slide mechanism and has an optional drive tip for direct-push, discrete sampling applications. The drive tip (called SPLAT™—SimulProbe® Latch Activated Tip) seals the sample chamber until the target depth is reached. The SPLAT™ is released at the target depth to collect a discrete sample. Direct-push advancement platforms were used with an unlined Core Barrel Sampler for this evaluation.

VERIFICATION OF PERFORMANCE

The demonstration data indicate the following performance characteristics for the Core Barrel 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 63 to 100 percent, with an average sample recovery of 95 percent. Sample recoveries from 40 samples collected at the CSC site ranged from 31 to 100 percent, with an average sample recovery of 68 percent. Using the reference method, sample recoveries from 42 samples collected at the SBA site ranged from 40 to 100 percent, with an average recovery of 88 percent. Sample recoveries from the 41 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 Core Barrel Sampler and the reference sampler indicates that the Core Barrel Sampler achieved higher sample 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 Core Barrel 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 22 of the 24 Core Barrel Sampler and reference sampling method pairs (12 at the SBA site and 12 at the CSC site), a statistical analysis using the Mann-Whitney test indicated no significant statistical difference at the 95 percent level between the VOC concentrations in samples collected with the Core Barrel Sampler and those collected with the reference sampling method. A statistically significant difference was identified for two sample pairs collected at the CSC site. Analysis of the SBA site data, using the sign test, indicated no statistical difference between the data obtained by the Core Barrel Sampler and by the reference sampling method. However, at the CSC site, the sign test indicated that data obtained by the Core Barrel Sampler are statistically significantly different than the data obtained by the reference sampling method, suggesting that the reference method tends to yield higher concentrations in sampling coarse-grained soils than does the Core Barrel Sampler.

Sample Integrity: Seven integrity samples were collected with the Core Barrel Sampler at each site to determine if potting soil in an unlined sampler became contaminated after it was advanced through a zone of high VOC concentrations. Seven integrity samples were collected with the reference sampling method at the SBA site and five integrity samples were collected at the CSC site. For the Core Barrel Sampler, VOCs were detected in eight of the 14 integrity samples: six at the SBA site and two at the CSC site. The range of VOC concentrations detected above the analytical detection limit in the potting soil at the SBA site was: cis-1,2-DCE (2.10 to 4,410 micrograms per kilogram [μg/kg]); TCE (5.28 to 1,960 μg/kg); and PCE (less than 1 to 7.05 μg/kg). The range of VOC concentrations in the potting soil at the CSC site was: cis-1,2-DCE (8.04 to 9.33 μg/kg); 1,1,1-TCA (108 to 218 μg/kg); TCE (21.5 to 39.4 μg/kg); and PCE (286 to 602 μg/kg). These results indicate that the integrity of the unlined chamber in the Core Barrel Sampler may not be 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. Additionally, the developer claims that use of liners will reduce the potential for cross-contamination.

Reliability and Throughput: At the SBA site (clay soil), the Core Barrel Sampler collected a sample from the desired depth on the initial attempt 60 percent of the time. Sample collection in the initial push was achieved 76 percent of the time at the CSC site (sandy soil). The initial push success rate was less than 100 percent because of sampler malfunction and breakage. By conducting multiple pushes using a solid point drive to create a pilot hole, the Core Barrel Sampler collected all samples required for this demonstration. The pilot hole greatly reduced the amount of hammering required to advance the sampler and subsequent wear on the sampler. During the performance test in Grid 5 at the CSC site, all attempts to collect a sample in saturated sand at a 40-foot depth were unsuccessful. 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 Core Barrel 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 21.4 minutes per sample at the SBA site and 11.8 minutes per sample at the CSC site. For the reference sampling method, the average sample retrieval times at the SBA and CSC sites were 26 and 8.4 minutes per sample, respectively. A two-person sampling crew collected soil samples with the Core Barrel Sampler at 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 Core Barrel Sampler can be purchased for $2,700; the direct push platform can be rented for $750 per day plus $900 mobilization/demobilization per site. Operating costs for the Core Barrel Sampler ranged from $2,880 to $4,860 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 method 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 and performance analysis is recommended before selecting a subsurface soil sampling method.

A qualitative performance assessment of the Core Barrel Sampler indicated that (1) reliability of the sampler can be affected by improper activation of the SPLAT™; (2) the sampler is easy to use and requires approximately 1 hour of training to operate; (3) logistical requirements are similar to those of the reference sampling method; (4) sample handling is similar to the reference method; (5) performance range is primarily a function of the advancement platform; and (6) no drill cuttings are generated when using the Core Barrel Sampler with a push platform.

The demonstration results indicate that the Core Barrel Sampler can provide useful, cost-effective samples for environmental problem-solving. However, in some cases, VOC data collected using the Core Barrel Sampler may be statistically different from VOC data collected using the reference sampling method. Also, sample integrity may not be preserved when the unlined sampler is advanced through highly contaminated soils. As with any technology selection, the user must determine what is appropriate for the application and project data quality objectives.

Gary J. Foley, Ph.D.
Director
National Exposure Research Laboratory
Office of Research and Development