THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

ETV JOINT VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**GROUNDWATER SAMPLING TECHNOLOGIES**
APPLICATION:	**VOC-CONTAMINATED WATER SAMPLING**
TECHNOLOGY NAME:	**Kabis Sampler, Models I and II**
COMPANY:	**Sibak Industries Ltd. Inc.**

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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 to conduct a verification study of groundwater sampling technologies. This verification statement provides a summary of the results from a verification test of the Kabis Model I and II discrete–level point samplers.

DEMONSTRATION DESCRIPTION
In August 1999, the performance of six groundwater sampling devices was evaluated at the US Geological Survey (USGS) 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 water spiked with various concentration levels of six target volatile organic compounds. The target compounds (1,2-dichloroethane, 1,1-dichloroethene, trichloroethene (TCE), 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 and an optional “clean-through-dirty” trial 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 standpipe trials were supplemented with sampler deployments at groundwater monitoring wells in the vicinity of VOC-contaminated groundwater at the NASA Stennis facility. The Kabis sampling device was deployed in a number of 2-inch and 4-inch wells. Comparison samples were also collected using a submersible electric gear pump. The principal contaminant in the monitoring wells was trichloroethene. The groundwater monitoring test phase provided an opportunity to observe the operation of the sampling device under typical field-use conditions.

All technology and reference samples were analyzed by the same field-portable gas chromatograph-mass spectrometer (GC/MS) system that was 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, with the use of a headspace sampler in lieu of a purge-and-trap unit. The overall performance of the groundwater sampling technologies was assessed by comparison of technology and reference sample results with particular attention given to key performance parameters such as sampler precision and accuracy. Aspects of field deployment and potential applications of the technology were also considered.

Details of the demonstration, including an evaluation of the sampler’s performance, may be found in the report entitled *Environmental Technology Verification Report: Sibak Industries Ltd. Inc., Kabis Sampler,* EPA/600/R-00/054

TECHNOLOGY DESCRIPTION
The Kabis Sampler is a discrete-level, grab sampler. The two models evaluated in this test operate on the same principle and only differ in size and sampling capacity. Both samplers are constructed of 321 stainless steel. The Model I is 17.4 inches long, 1.75 inches in diameter, and weighs 6.5 pounds. The Model II is 22.3 inches long, 3.65 inches in diameter and weighs 15.5 pounds. Both samplers have a removable top into which a single (Model I) or three (Model II) 40-mL VOA vial(s) are screwed prior to sampler deployment in the well. The sampler is attached to a measuring tape and is manually lowered into the water column. The size and orientation of the inlet and exhaust ports of the sampler are such that it does not fill while it is being lowered down through the water column in the well. When the sampler is held stationary at the desired sampling depth, it begins to fill under hydrostatic pressure. Fill duration time is about 5 minutes for the Model I and 8 minutes for the Model II.

Air inside the sampler escapes through an exhaust port as the installed sample vials fill from the bottom upward. The vials are flushed with about 6 vial volumes prior to the collection of the final vial volume at the end of the sampling cycle. The flush water flowing through the vials spills into the sampler body through spill ports located in the vial holder in the sampler head. Following completion of the fill cycle, the sampler is manually retrieved to the surface and the sample vials removed. The sample is then preserved, if required, and the vials are capped with positive-displacement-type caps that ensure a bubble-free sample. Sampler decontamination is carried out by rinsing the sampler in the field using a 5-gallon bucket of detergent water followed by several deionized or distilled water rinses.

Costs for the Kabis samplers are $825 for the Model I and $1,895 for the Model II. Additional sampler accessories available include a delivery tape, wooden storage box, and positive-displacement VOA vial caps.

The Model I and Model II samplers differ only in their size and number of vials filled during sampling. The samplers were used interchangeably in the study and their performance results are combined. Hereafter, the two sampler models are simply referred to as the Kabis sampler.

VERIFICATION OF PERFORMANCE

The following performance characteristics of the Kabis sampler were observed:

Precision: The precision of the sampler was determined through the collection of a series of replicate samples from four 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. Kabis sampler precision, represented by the relative standard deviation, for all compounds at all concentrations and sampling depths evaluated in this study, ranged from 2.9 to 25.8%, with a median value of 10.7%. Reference method precision ranged from 4.1 to 17.6%, with a median relative standard deviation value of 8.7%. In 16 cases, the relative standard deviation of the Kabis samples was greater than the reference samples, with Kabis precision less than or equal to reference sample precision in the other 8 cases. The F-ratio test was used to assess whether the observed precision differences between Kabis and reference samples were statistically significant. Test results showed that precision differences between Kabis and reference were statistically insignificant at the 95% confidence level in 23 of the 24 cases.

Comparability with a Reference: Kabis sampler results from the standpipe trials were compared with results obtained from reference samples that were collected at the same time. Both Kabis 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 VOC compounds at all concentrations and sampler depths used in this study ranged from -39 to 18%, with a median difference of -3%. The t-test for two sample means was used to assess whether the observed differences in Kabis sampler and reference sample results were statistically significant. These tests revealed that in 16 of 24 trials, the differences were not statistically different at the 95% confidence level. Of the remaining 8 cases, 5 showed a statistically significant Kabis sampler negative bias; and in 2 of those cases, the negative bias for PCE was in excess of 25%.

Versatility: Sampler versatility is the consistency with which the sampler performed over the ranges of target-compound volatility, concentration levels, and sampling depths. The standpipe tests reveal generally consistent performance with regard to Kabis sampler precision. Kabis sampler results show low recovery for TCE and PCE at the higher (~200 µg/L) concentration at the deeper (91 ft) sampling location used in this evaluation. In light of these results, the Kabis sampler is judged to have limited versatility.

Logistical Requirements: The sampler can be deployed and operated in the field by one person. About 1 hour of training is generally adequate to become proficient in the use of the system. The sampler is compact and can easily be hand carried to the wellhead for use. Decontamination of the sampler can be carried out in the field by using a detergent water rinse followed by several distilled water rinses. A reasonable degree of manual dexterity is required to remove the sample vials from the sampler head without sample loss. Sampling vials that have been pre-preserved cannot be used in this sampler. Preservative must be added following sample collection, if required.

Overall Evaluation: The results of this verification test show that the Kabis sampler can be used to collect VOC-contaminated water samples that are generally indistinguishable from a reference method with regard to precision. Sampler recovery, relative to reference samples, was acceptable for four of the six target compounds. Test results indicated low sample recovery with the Kabis sampler for TCE and PCE at high concentrations at both shallow and deep sampling locations.

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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