AMPLIFIED GEOCHEMICAL IMAGING LLC

Description of Service

Soil Gas and Subslab Soil Gas Sampling

Introduction

Amplified Geochemical Imaging, LLC (AGI) Surveys, utilizing AGI passive samplers (proprietary, passive, sorbent-based samplers), have been used successfully at thousands of sites to delineate source and extent of subsurface areas impacted by volatile and semi-volatile organic compounds (VOCs, SVOCs). These compounds are associated with a wide range of petroleum and chlorinated products, fuels, solvents, creosotes, chemical agents and explosives.

Common applications include detection of compounds to: 1) delineate source and extent of soil and groundwater contamination in porous and fractured media, 2) monitor progress of subsurface in-situ remedial actions, 3) provide data for real estate transfers and Brownfield investigations, 4) provide vapor intrusion data, 5) reduce groundwater monitoring costs, and 6) provide conceptual site model information. The AGI Survey is used in Triad investigations. Prudent use of this technology can optimize and reduce subsequent sampling and monitoring efforts resulting in significant cost savings in any of these applications.

AGI Passive Sampler Description

The AGI passive sampler is a proprietary, passive, sorbent-based sampler which collects volatile and semi-volatile compounds present in air, soil gas and water. The sampler is constructed of an ePTFE membrane tube. The membrane is chemically-inert, vapor permeable and waterproof. The membrane has over 80% open area and pore sizes that are 1,000 times larger than the largest semivolatile organic vapor molecule. The membrane does not adsorb compounds or offgas chemicals. Engineered adsorbents are housed within the ePTFE membrane tube. The adsorbents were selected due to their affinity for a broad range of organic compounds while having minimal water vapor uptake. The adsorbents are located near the bottom of an approximately one (1) foot length of the membrane tube which is fashioned with a loop. The loop is used as a means of tying the sampler to a string to facilitate installation and retrieval.

The unique membrane is hydrophobic and excludes liquid water, and does not retard vapor transfer, thus allowing VOC and SVOC vapors to penetrate the sampler freely and collect on the adsorbent material. This ability to protect the sorbent media from contact with ground and soil pore water, without retarding soil vapor diffusion, facilitates the application of the AGI Survey in virtually any geological site condition, while protecting sample integrity.

Quality Assurance (QA) Measures

As standard practice, all samplers are individually numbered and tracked throughout the manufacturing, field deployment, analytical, mapping and reporting steps. Completed samplers are sealed into clean glass vials, with caps having an identical serial number (barcode). All samplers are transported to and from the customer's site in the vials and boxes supplied by AGI, with custody seals. Additional samplers are included as trip blanks, and travel to and from the site. Associated method, manufacturing, and trip blanks are tested as QA controls. A rigorous quality system is maintained with documented procedures for all QA measures.

Installation and Retrieval Procedures

Installation of the samplers is typically performed by the customer. AGI passive samplers can be installed to any depth. For soil gas sampling, a slam bar or electric rotary hammer-drill is used to drive a 1/ 2 to 1-inch (2.5cm) diameter hole to a depth of three or more feet (1 meter) below grade. Subslab soil gas sampling is similar, but requires a rotary hammer or coring tool to advance the hole through the slab. Casing the hole is optional.

A length of string or cord is tied to the loop in the AGI passive sampler and to a supplied impermeable cork. The sampler is inserted into the hole, using the supplied stainless steel insertion rod. After each sampler insertion, the rod is removed, cleaned, and used at the next sample location. The cork is tamped flush with the surface to seal the hole. The cork provides an effective seal against air infiltration. If additional security is needed, a bentonite or plaster patch (water based only) can be applied over the cork.

Samplers identified as trip blanks should be noted on the Installation/ Retrieval log and left unopened in the shipping box for the duration of the field exposure. The log is updated along with the sitemap and any other required field notes.

Sampler retrieval requires that field personnel locate the sampler, remove the cork, grasp the cord and manually pull the sampler from each location. Corks and cord are separated from the samplers and discarded properly. The exposed samplers are returned to their respective numbered shipping vials, sealed, and placed in the shipping box. Boxes with field-exposed samplers and trip blanks are shipped with the Chain-of-Custody (COC) form, Install Log and insertion rod, to AGI's laboratory in Newark, DE via overnight courier.

Separate detailed installation and retrieval instructions are available and are provided with each sampler shipment.

Sampler Exposure Time

Site Assessment (relative mass reporting only): For site assessment applications where the primary objective is identification of potential source areas and extent of contamination, the suggested exposure time for soil gas sampling is 7 to 10 days, but can be less if the site is believed to be highly impacted.

Potential Vapor Intrusion with Soil Gas Concentrations: For surveys requiring estimated soil gas concentrations a sampler that has been characterized for vapor uptake is provided. For the most accurate results, exposure time must be limited to five days or less depending on the expected soil gas concentrations. Accuracy depends on limiting exposure so that adsorption remains constant over the entire sampling period. If concentrations are unknown a period of three to five days is recommended.

Analytical Procedures

Upon receipt of the samplers at the AGI laboratory, the inbound shipment is inspected and reconciled. The samples are logged and the COC is reviewed and signed.

Analytical instrumentation consists of gas chromatographs and mass selective detectors, as well as automated thermal desorption units. Sample preparation involves cutting the tip off the bottom of the AGI passive sampler and transferring an exposed sorber to a thermal desorption tube for analysis. No further sample preparation is required. The replicate samples are retained for approximately two weeks after the initial analysis. Results are reported electronically in Microsoft®-Excel® formatted data tables.

Analytical Method Quality Assurance

Prior to the analysis of samples mass spectrometer tuning and instrument calibration are verified, and method blanks are analyzed. The tuning, calibration, and system cleanliness is re-verified per method requirements. Positive identification of target compounds is determined by the presence of characteristic ions and retention times consistent with reference standards, and in accordance with the analyst's judgment. All analytical data are typically reported as a mass of analyte in micrograms (µg) per sample.

Vapor concentration data are available. The AGI passive sampler has been evaluated using criteria consistent with ASTM[1], MDHS[2], and other approved and accepted methods. Measured, compound-specific uptake rates, exposure times, temperature, and desorbed masses are entered into a model developed from laboratory studies. For soil gas concentrations, the resistance to diffusion in the soil is accounted for by also entering total porosity and water-filled porosity into the model. The terms and

procedures for soil gas adjustments were adopted from the research of Johnson and Ettinger[3] (1991) and Millington and Quirk[4] (1961).

Soil Gas Data Interpretation

In general, the detection of VOCs and SVOCs in field-exposed samplers indicates that potential sources (i.e. soil adsorbed, dissolved, and separate-phase organics) of the detected compound(s) may exist in proximity to the AGI passive sampler location. The sampler will adsorb migrating gases present in the adjacent media (soil or water).

The processes that govern the movement of gases in the subsurface are complex, involving interactions between the soil, soil moisture, pore gasses, groundwater, natural and human-made barriers, and the volatile contaminant. Chemical and microbiological processes can further influence the presence of soil gases, by reacting with or metabolizing these compounds.

Vapor pressure, water solubility, molecular weight, and the Henry's Law partitioning coefficient, are important chemical parameters to consider when interpreting soil gas data. The Henry's Law coefficient reflects a compound's propensity to partition from water into the vapor phase. Knowledge of this property aids in understanding an organic chemical's likely state in the subsurface. An understanding of the site geology (geologic structure, geochemistry), hydrogeology and operational history are also important when interpreting the distribution of soil gases.

A strong correlation is often observed between the soil gas mass levels and the compound concentrations located in the subsurface during subsequent sampling.

Contour Maps

Graphic presentation of the soil gas and subslab soil gas data extracted from AGI passive samplers are normally presented by overlaying the contamination patterns (contours) onto CAD maps supplied by the customer. Either minimum curvature or kriging interpolation are available. Standard "B-sized" (11" x 17") color contour plots are included with each project. Larger plots are available upon request. The site plan basemap(s) provided by the customer must include a scaled drawing with relevant site features, and a layer containing the AGI passive sampler locations and sampler serial numbers for the survey. Contour maps are provided electronically as PDF files, and are also available in a variety of other electronic formats.

Tentatively Identified Compounds (TICs)

The AGI passive samplers may contain non-target analytes (compounds not on AGI's target list). AGI can provide tentative identification of prominent non-target compound peaks (TICs). These compounds can include non-target soil gas analytes, and contaminants introduced during sample transport and installation/ retrieval activities.

Final Reporting

The results of the AGI Survey are summarized in a brief report, which will include the chain of custody, analytical data summary table, sample chromatograms, comments, and color contour maps. A full laboratory analytical data deliverables package incorporating calibration information, analysis, results of samples, standards and blanks, and mass spectra compared to standards for all detects, can be provided as an option. The Final Report and maps are available in electronic (PDF) format.

References

1. ASTM Methods, 6306-98, 4597-03, 6246-02, y 5314-93
2. MDHS Methods, 27, 70, y 80
3. User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings. 2000. PN 050240.004. www.epa.gov.
4. Millington, R.J. and J.M. Quirk. 1961. "Permeability of Porous Solids." Trans. Faraday Soc. 57:1200-1207.

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