Evaluation of Direct-Push Soil-Gas Sampling Methods to Support Assessment of Vapor Intrusion

Introduction

Vapor intrusion is defined as vapor-phase migration of volatile organic compounds (VOCs) or inorganic compounds into occupied buildings from underlying contaminated ground water or soil. Until recently, this transport pathway was not routinely considered in RCRA (Resource Conservation and Recovery Act), CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act), or underground storage tank investigations. Therefore, the number of buildings or homes where vapor intrusion has occurred or is occurring is undefined.

However, considering the vast number of current and former industrial, commercial, and waste-processing facilities in the United States capable of causing volatile organic/inorganic ground water or soil contamination, contaminant exposure via vapor intrusion could pose a significant risk to the public. Also, consideration of this transport pathway may necessitate review of remedial decisions at RCRA and CERCLA sites, as well as implementation of risk-reduction technologies at brownfield sites where future development and subsequent potential exposure may occur.

EPA's Office of Solid Waste and Emergency Response (OSWER) developed guidance to facilitate assessment of vapor intrusion at sites regulated by RCRA and CERCLA, where halogenated organic compounds constitute most of the risk to human health. EPA's Office of Underground Storage Tanks is considering modifying this guidance to include underground storage tank sites where petroleum compounds that primarily determine risk and biodegradation in subsurface media may be a dominant fate process.

The OSWER guidance provides attenuation factors for use with soil-gas concentrations to assess the potential for vapor intrusion at a given site. Due to the expense of drilling and installation of dedicated vapor probes, truck-mounted direct-push methods (such as the Geoprobe Post-Run Tubing [PRT] system) are commonly used to sample soil-gas at depths greater than 50 feet near homes in streets and driveways. Hand-held rotary-hammer methods (such as the AMS rotary-hammer system) have been used to sample soil-gas at depths less than 15 feet within 3 feet of a house, especially when there is concern regarding extrapolation and interpolation of data from a more distant location. However, information is lacking in the referred literature on potential bias associated with direct-push sampling methods compared to dedicated vapor probes (which is the generally accepted reference method). Thus, an assessment of bias associated with direct-push sampling methods is necessary to support the OSWER guidance and vapor intrusion investigations.

Background

Soil-gas sampling will be conducted near homes east of the former Raymark Superfund site in Stratford, Connecticut. Ground water 15 to 20 feet beneath these homes is contaminated with 1,1,1-trichloroethane, trichloroethene, 1,2-cis-dichloroethene, 1,1-dichloroethene, and benzene.

Objectives

The objective of this work is to assess potential bias (compared to dedicated vapor probes) of two direct-push soil-gas sampling techniques: the truck-mounted Geoprobe PRT system and the hand-held AMS rotary-hammer system. The results of this investigation will be used to provide specific recommendations on soil-gas sampling to support vapor intrusion investigations.

Approach

Dedicated vapor probes and probes from Geoprobe PRT and AMS rotary-hammer systems will be sampled at identical depths (3, 7, and 11 feet) at distances less than 3 feet from each other. The sequence of testing will be varied to avoid potential bias in sample concentration due to sampling sequence.

Six to nine soil-gas samples will be collected at the same depth using the Geoprobe PRT system within an area of 3 square feet to assess spatial variability. This testing is necessary to separate concentration differences due to sampling methodology from random variation. Selected dedicated vapor probes, Geoprobe PRT, and AMS rotary-hammer probes will be sampled after a variety of purge volumes (up to 200) to assess the impact of purging prior to sampling. Oxygen, carbon dioxide, and total VOCs will be monitored in the purge stream continuously, using a Landtec landfill gas meter and portable photoionization detector.

Experimental Design

Vapor samples from all three systems will be collected into Tedlar bags using a peristaltic pump, Teflon tubing, and a Masterflex tubing. Use of a peristaltic pump will ensure that sampled air does not circulate through a pump, causing potential cross contamination and leakage. All tubing will be discarded between sampling locations to eliminate the possibility of cross contamination. Sample flow rate will be set from 0.5 to 1 liters per minute and measured using a flow meter. Tedlar bags used for sample collection will be analyzed onsite by EPA's New England Regional Laboratory, using a field-based gas chromatograph. The sampling train for collection of vapor samples from dedicated vapor probes is illustrated in Figure 1. Probes used for the Geoprobe PRT system and AMS system are illustrated in Figures 2 and 3, respectively.

Figure 1: Sampling train (peristaltic pump, flowmeter, landfill gas meter) for collection of samples from dedicated vapor probes

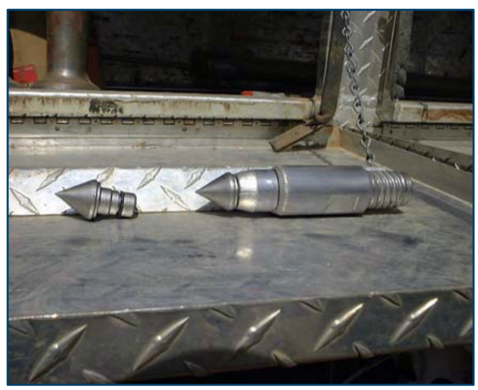

Figure 2: Probe used for Geoprobe PRT system

Figure 3: Probe used for AMS vapor sampling system

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Accomplishments

Sampling has been completed. EPA report preparation is in progress.

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