Measuring Trace Level VOCs in High Concentration Soil Gas Matrices: A New Tool to Meet Risk-Based Screening Levels

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Background/Objectives. Vapor intrusion investigations often rely on VOC measurements in soil gas to evaluate potential health risks to occupants of nearby buildings. Risk is often driven by a small number of highly toxic chemicals with screening levels in the sub-ppbv range. While EPA Method TO-15 can be configured to achieve most risk-based soil gas screening levels, soil vapor often contains significant matrix which prevents achieving project required action limits. For example, soil vapor samples containing high concentrations of petroleum hydrocarbons must be diluted in order to avoid gross contamination of the TO-15 instrumentation, elevating the reporting limits for risk drivers and often resulting in non-detect values at reporting limits several magnitudes higher than the action limit. High concentrations of co-eluting matrix peaks can also confound the identification and accurate quantification of the target chemicals. To effectively evaluate risk and support decisions regarding site closure, new analytical techniques are required to measure trace level VOCs in these challenging soil gas matrices.

Approach/Activities. A novel solution was developed to remove interfering peaks and isolate selected risk drivers through a sequence of gas chromatographic separations and timed concentration steps conducted during the analytical run. Compound detection was achieved using a time-of-flight mass spectrometer (TOF-MS) which provided improved selectivity and sensitivity as compared to a conventional quadrupole mass spectrometer. The enhanced sensitivity of the TOF-MS allowed the lab to reduce the volume of soil gas required to meet the screening levels, thereby minimizing contamination of the air interface. This modified TO-15 method was applied to the measurement of selected VOCs in samples containing total hydrocarbons in the 0.1 to 0.5% range. Validation was initially conducted using samples generated in the laboratory in which sub-ppbv concentrations of specific target VOCs were spiked into high concentration hydrocarbon vapor mixtures. The collection of field samples is planned to evaluate method performance for a range of soil gas matrices encountered at sites highly impacted with hydrocarbons.

Results/Lessons Learned. As compared to analysis on a conventional TO-15 unit, reporting limits were lowered by nearly 5 orders of magnitude for the hydrocarbon samples prepared by the laboratory. The target VOC peaks were easily identified in samples with excellent spectral match to the NIST library reference spectra. Accuracy objectives of 70-130% were met for each of the targeted VOCs. Performance of the modified TO-15 method will be evaluated using field samples to verify that the chromatographic configuration is applicable to a range of soil gas matrices for a number of targeted VOCs commonly driving risk at vapor intrusion sites.