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Vertical Screening Distance Criteria to Evaluate Vapor Intrusion Risk from Lead Scavengers

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Background/Objectives. Ethylene dichloride (EDC) and ethylene dibromide (EDB) were used as lead scavengers in leaded gasoline until on-road use was banned in the US in 1996 (except in aviation gasoline and racing fuels). EDC and EDB could still occur in soil and groundwater impacted by historical leaded-gasoline releases. The potential for vapor intrusion (VI) into any overlying buildings needs to be evaluated because of the volatility and toxicity of these compounds. EDC and EDB are known to biodegrade under both anaerobic and aerobic conditions, however the ubiquity and kinetics of these biodegradation processes in the vadose zone are not well understood. Due to this data gap and the lack of empirical data on EDC and EDB, the U.S. EPA recommends that sites with EDB and EDC impacts be further evaluated[1]. The current vapor intrusion screening levels (VISLs) for EDC and EDB in groundwater or soil vapor are based on simple attenuation factors relating indoor air to groundwater or soil vapor concentrations[1]. These do not account for potential biodegradation in the vadose zone and thus may be overly conservative. Since the majority of current EDC and EDB detections in the subsurface likely resulted from leaded gasoline releases that occurred over 20 years ago, it is reasonable to believe that combined effects of natural attenuation and low initial concentrations have reduced the potential for VI. However, this needs to be demonstrated with empirical data on EDC and EDB.

Approach/Activities. The current API study presents a two-pronged approach to address this data gap:

1. Empirical data analysis of available EDC and EDB soil vapor and groundwater data from completed PVI investigations to develop vertical screening distance criteria (like benzene[1]), and
2. Application of an analytical vadose zone transport model (e.g., BioVapor) to available soil vapor profiles of EDC and EDB from select sites to calibrate first order biodegradation rate constants and predict vertical screening distances.

Results/Lessons Learned. Based on this analysis of 103 pairs of EDC soil vapor and groundwater concentration data, only six detections of EDC in soil vapor were observed. These detections were limited to a vertical distance of 10 ft from the groundwater table (vapor source). Application of the BioVapor model to these soil vapor profiles yielded a median vertical screening distance of 9 ft. Given the large number of non-detects in this limited dataset, additional PVI investigation data are being explored and compiled to broaden this analysis to a potentially larger dataset. However, such empirical analysis is not feasible for EDB as the reporting limits in the existing data are higher than the EDB soil vapor screening level (0.16 µg/m^3 EDB for 10^{-6} incremental excess cancer risk). As such, additional soil vapor sampling and analysis for EDB

1. USEPA. Technical Guide For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage Tank Sites. EPA 510-R-15-001, June 2015 http://www.epa.gov/oust/cat/pvi/pvi-guide-final-6-10-15.pdf

with improved analytical reporting limits will be needed at sites with groundwater EDB concentrations to understand the fate and transport of EDB in vadose zone.