C16 Free Product Determination Using Ethylbenzene to Total Xylenes Ratio

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After attending this presentation, attendees will understand a complimentary method to determine whether or not a petroleum free product is in the soil.

This presentation will impact the forensic science community by putting another tool in attendees toolbox for use at petroleum-contaminated sites.

During a 2005 kerosene UST assessment, concentrations of diesel range organics (DRO) (140,000 - 4,900,000 ug/kg) were reported in the shallow samples. However, the absence or generally low levels of polynuclear aromatic hydrocarbons (PNAs) and volatile organic compounds (VOCs) associated with these samples do not support an association with free phase conditions.

During the 2009 and 2010 supplemental soil boring sampling activities, selected samples in which total VOCs did not exceed 75,000ug.kg were additionally analyzed for gasoline range organics (GRO) (C-6 to C-10). Based on the available data, however, no specific data trend or correlation of total VOCs versus GRO was identified. Because of the absence or very low levels of PNAs reported in these soil samples, no additional DRO analysis was deemed necessary in order to assess for diesel range free phase conditions.

An evaluation using the Ethylbenzene/Xylenes Ratio (EXR) Method (DeWitt, Smith, and Hoitash, 2008) determined that the residual contaminant levels reported in soil samples do not represent free phase conditions. Gasoline and middle distillates (ie., diesel, kerosene, and fuel oils) have composition ethylbenzene/xylenes ratios (EXRs) of approximately 0.20±0.05. Long term sources of contamination will continue to supply contaminants to the environment and replace those which are transported away from the source area, are biodegraded, or removed through remediation (Alexander, 1999). Upon a release, bacteria rapidly uses available oxygen, driving the release environment anaerobic. Anaerobic biodegradation removes xylenes faster than ethylbenzene (Reinhard, Hopkins, and LeBron, 2005), thus EXRs increase with time. An EXR of approximately 0.25 or greater indicates anaerobic biodegradation (Smith and DeWitt, 2006). Release areas can act as continuing sources having extremely slow biodegradation resulting in continued elevated contaminants and EXR values typically greater than 0.15 and less than 0.25, but can vary pending site-specific conditions and release compositions. EXR data not showing an increasing trend and remaining near the range anticipated for product can indicate the presence of "free product" and/or significant source material (e.g., free phase conditions).

The EXR values for the cumulative data for the VOCs consistently reported (2005 to 2009) will be presented. In general, for the samples exhibiting benzene concentrations, which would be expected to be present if free phase conditions were acting as a continuing source of contaminants, the EXR values are above 0.25 (i.e., 0.33 to 1.71) indicating that biodegradation is occurring and that free phase conditions cannot be present. The highest VOCs concentrations in this group are represented by the former excavation sidewall sample S-17 (EXR - 0.58) and soil boring sample SB-3 (EXR - 0.35), which might be considered as having free phase conditions. However, the EXR values for samples S-17 and SB-3 and the lower levels of contaminants in the other samples are not representative of free phase conditions.

Based on the above weight of evidence approach and given the volume of removed source soils, it is not probable that free product or free phase conditions are present at the site.

EXR, Free Phase Petroleum Product, Soil

 ** Presenting Author*