Bioremediation and Sustainable Environmental Technologies—2017. Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies (Miami, FL; May 2017). ©2017 Battelle Memorial Institute, Columbus, OH, www.battelle.org/biosymp. A. Barton and S. Rosansky (Chairs)

An Alternate Approach to Risk Assessment and Plume Estimates Using Incremental Sampling Methodology

Kathlyne Hyde (kathlyne.hyde@usask.ca), Wai Ma, Steven D. Siciliano, (University of Saskatchewan, Saskatoon, SK, Canada)
Terry Obal (Maxxam Analytics, Mississauga, ON, Canada)
Trevor Carlson (Federated Cooperatives Limited, Saskatoon, SK, Canada)

Background/Objectives. Incremental sampling methodology is an approach used to obtain representative data for a site that ultimately leads to more responsible management decisions. The traditional method of using discrete sampling for petroleum hydrocarbon contaminated sites often inaccurately estimates the degree of contamination leading to unnecessary cleanup goals. In Western Canada, the highly heterogeneous glacial till soils and freeze thaw conditions make estimating the average concentration of concern for a site difficult and possibly unreliable. The methods used in incremental sampling reduce the fundamental error associated with the heterogeneous nature of the soil by increasing the mass of soil used for analysis, as well as reducing costs for sample analysis. As part of the Sustainable In Situ Remediation Cooperative Alliance (SIRCA), we wished to compare discrete sampling and incremental sampling estimations of contaminated soil volume and site risk.

Approach/Activities. Two contaminated sites in Saskatchewan, Canada were sampled and each site was divided into four decision units. The rationale for the decision units was to identify the source area, plume, delineation of the plume, and clean areas. Each decision unit had three unbiased locations for cores of 6 meter depths to be drilled using a Geoprobe. Each borehole was then conceptually viewed vertically and divided into three vertical decision units: i) Surface zone at 0-1.5 meters, ii) Contaminated zone at 1.5-4.5 meters, and iii) Deep zone at 4.5 6.0 meters. From each vertical decision unit, a plug (n=30), wedge, and discrete sample was taken. Subsamples of the plug, wedge, and discrete samples were immediately placed in methanol to preserve volatiles, while the remainder of the plug and wedge samples were homogenized using the 2-D Japanese Slabcake method. Maxxam Analytics analyzed all three sample types for hydrocarbons from the initial sampling. An additional experiment was carried out entirely at the University of Saskatchewan to compare 30 discrete samples to one plug sample in three contaminated cores. This data was used to estimate differences in volume and risk estimates between traditional and incremental sampling methodologies.

Results/Lessons Learned. We were able to rapidly implement incremental sampling methodology on push core sleeves in a laboratory setting. The plug sampling method of incremental sampling was the easiest and most reproducible method for collecting volatile and semi-volatile samples. The wedge sampling method was highly dependent on soil structure and was rarely reproducible. The plug method is a more effective way to assess overall mass of contaminates and concentration of concern. Our experience suggests that incremental sampling should likely be performed in conjunction with traditional screening techniques, with incremental samples pulled from decision units that traditional screening techniques have identified as contaminated. This will allow us to estimate the mass of contaminant in the subsurface, rather than just a point estimate of maximum concentration.