Real-Time Measurements of Hydrocarbon Concentrations in Soils

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Background/Objectives. Portable field instruments can enable time and cost efficiencies in site investigation and monitoring. For example, measurements of total petroleum hydrocarbons (TPH) and/or individual components in soils and groundwater are often necessary to delineate hydrocarbon impacts at remediation sites, evaluate remedial endpoints, and satisfy regulatory requirements. These measurements can be obtained in analytical laboratories, typically using gas chromatography with a flame ionization detector (GC-FID). However, lengthy turnaround times for laboratories (weeks to months) can cause significant delays in field operations (e.g., during soil treatment processes) and per-sample costs may limit the number of samples analyzed.

Approach/Activities. To address the need for field measurements of TPH in soils, a rapid handheld infrared (IR) device ("IR Gun") was evaluated at multiple field sites impacted with crude oil. Reflectance IR spectra can be acquired easily and rapidly because of the high sensitivity of alkyl-CH3 vibrational group. Partial least squares (PLS) and cross validation techniques were used to develop equations for quantification of TPH. The impacts of soil moisture, grain size, and hydrocarbon type on the accuracy of results reported on the IR gun were also evaluated.

Results/Lessons Learned. Results show that, following site-specific calibration, the device is able to provide TPH measurements on the order of minutes for significantly less cost than laboratory methods. Our data show that neat whole soils with water contents up to 30 wt% could be measured without significant loss of accuracy in reported TPH results. Results also show that the lower detection threshold of the calibrated model is sensitive to soil grain size. The small contact window of the IR gun results in an elevated lower detection threshold for sites with larger grain sizes. For example, at one site where soils consisted of medium sand, the lower detection threshold for the IR gun was ~ 5,000 ppm, while at a site with clay soils, the lower detection threshold was ~ 2,000 ppm. In contrast, variability in crude oil character did not have an impact on the readings for the sites tested in this study. Overall, results show that the IR gun can deliver real time results for field screening of crude oil impacted soils, when calibrated with a site-specific model. This approach can potentially lead to significant time and cost savings and increase decision making efficiency through reducing the need for laboratory analytical techniques.