Field Tests with the OIP-Green DP Photologging System for Detection of Coal Tars

Wesley McCall (mccallw@geoprobe.com), Thomas M. Christy, Daniel A. Pipp, and Ben Jaster (Geoprobe Systems, Salina, KS)
Rick Bean and Ian Smith (GSI Engineering LLC, Wichita, KS)
Gary Richards and Jonathan Stephenson (Kansas Dept. of Health and Environment, Topeka, KS)

Background/Objectives. The optical imaging profiler (OIP) is a new direct push photologging system developed by Geoprobe® that uses a down hole light source and complementary metal-oxide semiconductor (CMOS) camera to investigate for fluorescent contaminants through a sapphire window in unconsolidated formations. The OIP probe was initially developed with an ultraviolet (UV/275 nm) light emitting diode (LED) for the detection of fuel fluorescence. Several common organic contaminants of concern (coal tars, creosote, bunker fuels) yield inconsistent results under UV light but do fluoresce under green wavelength light. Because of this need Geoprobe® has pursued development of an OIP probe with a green wavelength (525 nm) light source. The downhole camera acquires images of fluorescence at 30 frames per second that are displayed onscreen while logging. The images are analyzed for the percent area of fluorescence (%AF) and one image every 0.05 ft (15 mm) is saved to file. The OIP probe includes a dipole electrical conductivity (EC) array for the measurement of bulk formation EC. The EC and %AF logs are displayed onscreen along with the images as the probe is advanced at approximately 2 cm/sec by a direct push (DP) machine.

Approach/Activities. Initial bench tests were conducted using coal tar contaminated soil from the site to confirm detection with the OIP-G system. Following this Geoprobe coordinated with KDHE and its contractor GSI to conduct a test of an OIP-G probe at the former manufactured gas plant in Wellington, Kansas. Logging with the OIP-G system was performed at 39 locations to depths of up to 33 ft. The logs revealed the presence of significant fluorescence at several locations and depths. Sampling was performed at selected locations and targeted depths based on the fluorescence log. The samples collected with the DT22 soil coring system were submitted for analysis of polynuclear aromatic hydrocarbons (PAH).

Results/Lessons Learned. The OIP-G logs defined zones of elevated fluorescence at several locations/depths. Zones of high concentration/free product coal tars were confirmed by soil sampling and analysis for PAHs. Importantly, sampling revealed that false positive results (up to 40%AF) were detected at some locations/depths. Inspection of the cores and bench tests revealed that these false positive results occurred due to the presence of calcite bearing minerals. Fluorescence of calcite is well documented. Visible light images with the initial OIP-G probe were of poor quality due to the low pass filter over the camera. In an attempt to improve images for soil texture evaluation an infrared (IR) LED replaced the visible light LED in a modified probe for a later round of testing. The IR images avoid the low pass filter limitation but intensity needs to be increased for improved image resolution. Following field work, cross sections with EC and %AF logs helped to define the presence and distribution of coal tars in the subsurface and identify preferential migration pathways. These results indicate that the OIP-G system will be a useful tool for investigation of coal tar contaminated facilities.