Surfactant Enhanced Recovery of Separate-Phase Petroleum Hydrocarbons

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Amtrak Sunnyside Yard is located in Queens, New York City, New York. Historically, the northern portion of the yard (OU-3) has served as a maintenance facility for electric locomotives and railroad cars as well as a layover storage yard. These activities created an aged separate-phase petroleum hydrocarbon (SPH) plume which contains polychlorinated biphenyl (PCB) contamination. In 2007 the NYSDEC issued a Record of Decision (ROD) for OU-3, requiring clean up levels of less than 0.1 foot SPH thickness, and ultimately suspending any future railroad expansion. Many remedial actions and Interim Remedial Measures (IRMs) have been completed in OU-3 over the decades, long before the OU-3 ROD was issued, including the removal of visually-impacted surface soil, the removal of PCB and lead hot spot soil, and the demolition and removal of old structures, inspection pits, and underground storage tanks. In addition to excavation remedies, other remediation methods were necessary to address inaccessible areas such as those beneath and adjacent to existing tracks. A Dual Phase Vacuum Extraction (DPVE) system was installed in October 2013 to recover SPH. This system consists of 41 extraction wells, and has been operational since startup. To date, the DPVE system has recovered nearly 2,000 gallons of SPH. However, SPH recovery using the DPVE system reached an asymptotic state with diminishing recovery rates. This was confirmed by completing SPH transmissivity testing and modeling, which found that the remaining SPH in OU-3 has very limited mobility and can no longer be recovered effectively using the DPVE system. Therefore, an amended remedial action(s) was needed to address the remaining SPH plume source areas in OU-3.

Bench-scale studies were performed using four different technologies geared toward enhancing recovery of SPH while also verifying that PCBs would not be mobilized in groundwater. Bench studies were conducted between December 2014 and April 2015 using the following technologies: oxidation (peroxide and persulfate); surfactants and thermal energy (i.e., hot water). Bench testing results showed that Iveysol® 106 (Ivey-sol), a proprietary surfactant from Ivey, appeared to be the most optimal technology to enhance the recovery of SPH in OU-3 soils by improving SPH mobility and solubility. Ivey-sol also did not increase PCB solubility in groundwater nor did it cause any other negative effect on groundwater quality (i.e., change in pH). These findings were sufficient to support proceeding to field pilot testing.

The NYSDEC approved the Surfactant Pilot Study Work Plan in October 2015 and field work began shortly thereafter. The objectives of the pilot study were to determine the feasibility of using a surfactant to enhance the recovery and treatment of the mobile SPH plume and associated hydrocarbon impacted soils within OU-3, and to evaluate the potential effects on bioremediation which was previously and concurrently implemented. To introduce the surfactant, the Ivey-sol was first diluted with a pre-determined amount of potable water and then either gravity-fed into the extraction wells or injected into the ground immediately above the water table via Geoprobe. Several ratios of water to surfactant solutions were tested ranging from 5:1 to 20:1. This range encompasses the ratios suggested by Ivey as a result from their bench scale tests. Multiple test areas were also employed, each utilizing a different configuration of injection and extraction well(s). It can be concluded from this pilot study that direct push-pull – using a single well as both the injection and extraction points – is effective in removing SPH. Other configurations using multiple injections surrounding one extraction point or linear draw were

less successful. In addition, surfactant remediation can be conducted in areas undergoing bioremediation without depleting the heterotrophic plate count. By the conclusion of this pilot study in February 2016, the SPH thicknesses had been significantly reduced in all of the push-pull wells. A full scale remedial work plan will be developed in 2016.