Subgrade Biogeochemical Reactors for Treatment of Petroleum Hydrocarbon Contamination

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Background/Objectives. Two new types of subgrade biogeochemical reactors (SBGRs) were constructed in late 2016 for treatment of petroleum hydrocarbon contamination at Travis Air Force Base. SBGRs are a unique green and sustainable remediation (GSR) technology for treatment of contaminant source areas and groundwater plumes. Since 2008, the SBGR technology has been successfully applied at 17 sites for treatment of chlorinated volatile organic compounds, and the technology has recently been implemented at two sites for treatment of petroleum hydrocarbon contaminants in soil and groundwater.

Approach/Activities. SBGRs typically consist of the following elements: 1) construction of a soil void space via excavation or large diameter augers, 2) backfill with gravel and several types of biogeochemical treatment media tailored to the contaminant(s) of concern, and 3) installation of a solar-powered pumping system to recirculate groundwater through the SBGR for treatment of the surrounding soil and groundwater. The use of off-grid groundwater pumping, locally sourced farm byproducts, reclaimed construction materials, and other non-refined, recycled, or waste products have created a low-cost, low-maintenance, and sustainable remediation approach.

Recirculation strategies are often limited by injection well fouling; however, SBGRs have been shown to avoid fouling issues due to the geochemistry and large surface area for infiltration within the SBGR. This recirculation approach has allowed for multiple pore volume exchanges per year within the target treatment areas, greatly accelerating in situ treatment processes with minimal operation and maintenance costs.

Results/Lessons Learned. Performance results and lessons learned from two different types of petroleum hydrocarbon SBGRs will be presented. The first case study relies on a recycled drywall product to support the sulfate-enhanced biodegradation pathway. Based on initial performance monitoring data, source area concentrations have been reduced by 98 to 99%. The second case study relies on several oxygen-enhancing processes, including a sequenced pulse-pumping strategy termed the “washboard effect” to support enhanced dissolution of the residual light non-aqueous phase liquid present in the source area and aerobic treatment of the dissolved-phase contamination. Biological and biogeochemical indicator data will be presented to provide insights into the degradation processes occurring within the SBGRs.