STARx (Ex Situ Smoldering): Field Pilot Test in Kaohsiung, Taiwan to Treat Base Oil-Impacted Soils

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Background/Objectives. STARx systems use smoldering combustion for the treatment of contaminated soils, where the contaminants provide the fuel that supports the combustion reaction. The reaction is a controlled, flameless and exothermic oxidation reaction that proceeds in a self-sustaining manner following a short duration, low energy input 'ignition event'. Recent developments have led to the design and deployment of a modular, engineered base "Hottpad" system to enable the application of STARx in large volume soil piles. This presentation describes the STARx Hottpad pilot testing program conducted on a former base oil plant in Kaohsiung, Taiwan (the "Site"), highlighting operational results and lessons learned.

Approach/Activities. A total of seven (7) tests were conducted to assess the treatment of hydrocarbon-impacted soils for a range of soil types (i.e., silt, sand and gravelly sand) and contaminant concentrations (i.e., 4,000 to 32,000 mg/kg). The tests were conducted using a STARx Hottpad system self-contained within a shipping container, which was designed for streamlined transport and pilot testing at new sites. The results of this pilot test allowed for the collection of Site-specific parameters critical for full-scale design and technology assessment, including treatment efficiency, heating times required to achieve ignition, smoldering front propagation rate, and emissions composition.

Results/Lessons Learned. The STARx pilot test in Kaohsiung, Taiwan successfully demonstrated treatment of Site silt and gravelly sands at initial TPH concentrations near or greater than approximately 4,000 mg/kg. Following STARx treatment, TPH concentrations were often reduced to non-detect levels, with limited areas containing residual TPH (i.e., less than 300 mg/kg). A modified injection air flow protocol for the heating period was developed during pilot testing to achieve these results. It was also demonstrated that low concentrations of canola oil can be used as an amendment to permit robust treatment of lower concentration Site soils, if desired, to expand the range of soils treatable via STARx.

Challenges were presented with the treatment of Site sands due to equipment limitations observed for the given soil conditions, which led to limited air distribution and consequent soil hardening. A series of additional laboratory studies were conducted to assess mineralogy and response of these materials to both heat and STARx treatment. It was found that equipment and operational modifications (i.e., improved welding practices during Hottpad fabrication, air injection blowers with a higher pressure capacity, and blending of silt and sands prior to treatment) could allow for more effective treatment of these soils.