**Overview**

The subject site is an operating oil field in California, USA. A STARx Hottpad™ demonstration system was deployed to treat hydrocarbon impacted soils and tank bottom sludges mixed with soils. The system consisted of a single Hottpad™ unit capable of treating up to 10 cubic meters of impacted materials per batch (m$^3$). The Hottpad unit was equipped with heating elements for ignition and an air distribution system to support the smoldering combustion reaction. Ancillary equipment associated with the system included blowers for air delivery, a control system for heater operation and air flow control, and a Thermal Oxidizer for vapor treatment (IMAGE 1).

**System Operation**

Contaminated soils were loaded into the Hottpad™ system up to a height of 1.2 meters (m), giving treatment volumes between 6.8 m$^3$ and 8.14 m$^3$ per batch (TABLE 1). A thin “clean soil cap” was then added to the top of the pile to acts as a heat sink. Five vertical multilevel thermocouple bundles were inserted into the pile to track temperatures during operations prior to sealing the vessel by closing the vapor capture hood (IMAGE 2).

**Conclusions**

The STARx technology is a rapid, safe, and low-cost treatment option for tank bottom sludges and hydrocarbon-impacted soils.

The Hottpad demonstration completed in California:

- Demonstrated self-sustaining smoldering combustion (i.e., no energy input into the system following ignition); and
- Reduced sludge concentrations to non-detect and near non-detect levels demonstrating excellent treatment efficiency; and
- Effectively treated volatile hydrocarbons in the STARx emissions stream using a Thermal Oxidizer, while increasing CO$_2$ and NO and reducing CO and SO$_2$.

**Operations Schedule**

<table>
<thead>
<tr>
<th>Operations Schedule</th>
<th>Volume of Contaminated Soil (m$^3$)</th>
<th>Percent Reduction in Petroleum Hydrocarbon Concentrations (%)</th>
<th>Propagation Rate (m/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>8.14</td>
<td>98 - 99.9%</td>
<td>0.45</td>
</tr>
<tr>
<td>Test 2</td>
<td>6.8</td>
<td>&gt; 99.9 %</td>
<td>1.12</td>
</tr>
</tbody>
</table>

**Table 1**: Test volumes and percent reductions in TPH content.

Multiple tests were completed to demonstrate system performance and process repeatability. Soil concentrations before and after treatment were compared to assess treatment effectiveness, and in-pile temperatures and combustion gases were monitored to track the progression of the combustion reaction. Analytical data shows excellent treatment efficiency (TABLE 1). This data was confirmed through visual assessment of the soils before and after system operation (IMAGE 3). Process emissions were also monitored for NO, SO$_2$, CO, and CO$_2$ before and after passing through the Thermal Oxidizer system. This data was used to assess the performance of the vapor treatment system at the demonstration scale, and to assist in the design of a vapor treatment for full-scale operations.

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