Innovative Combined Remedies Approach Using Liquid Activated Carbon (LAC) and Calcium Oxyhydroxide Applied to Benzene Plume Reaches Non-Detect Within 30 Days

Site Description/Project Background

Hydro (Ocon

An active gas station in the Pacific Northwest was impacted with BTEX concentrations from a petroleum release. Following remediation of the source, residual BTEX concentrations persisted in a down gradient well. A new combined remedies in situ program using PlumeStop[®] and ORC Advanced[®] was designed. Following the verification testing, REGENESIS[®] co-applied PlumeStop and ORC Advanced into the residual BTEX plume. After one month, sampling was conducted showing contaminants had been dramatically reduced to non-detect levels.

Background

Lingering, low-level dissolved phase plumes can pose challenges to achieving closure at what are often, not-well-characterized gas station sites.

Site

Active service station site in the Pacific Northwest with a persistent dissolved phase plume; impacted with MTBE, benzene, and tph concentrations from a petroleum release. Novel approach was utilized to achieve goals rapidly and with certainty. Initial remediation activities consisted of excavation, chemical oxidation (w/ozone and peroxide), AS/SVE, and enhanced aerobic bioremediation (w/oxygen release compound).

Despite best efforts, low-level residual BTEX (particularly benzene) and tph concentrations persisted. A novel, *in situ* remediation program was designed and implemented to achieve goals rapidly and with certainty; a combined remedy of liquid activated carbon and calcium oxyhydroxide.

DVT

REGENESIS Remediation Services, working closely with Hydrocon, completed a multi-step design verification test prior to injection program. DVT included:

What

- Clear water injection
- Soil borings/field hydrometer
- Pilot injection of liquid activated carbon
- Test aquifer properties
- Detailed characterization of
- the proposed treat area
- To test distribution



| Site Details |
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| Site Type: Active Service Station |
| Contaminate of Concern: Benzene and TPH-d |
| Concentration: Benzene at 19 ug/L and TPH-d at 500 ι |
| Remediation Approach: Sorption and Aerobic Biodegradation |
| Soil Type: Clay and Silt |

Treatment Area: 760 square feet

Technology Used:







Project site during injection activities



Project site during injection activities

Soil Settling Tube Tests (Field Hydrometers)

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Description of Remediation Approach and Technology Applied

REGENESIS worked closely with the project consultant to complete a multi-step verification process prior to remediation. This procedure included a clear water injection to test aquifer properties and soil borings for detailed characterization of the proposed treatment area. This was followed by a pilot injection of PlumeStop to test distribution. The verification testing found that despite soils at the site being classified as clays and silts, there was a sufficient amount of sand present to allow for good distribution. Injection pressures remained below 5 psi for PlumeStop and below 10 psi for ORC Advanced. Distribution of greater than 12 feet was also observed.

The verification process was an integral part of the project, helping to more accurately characterize true hydrogeologic conditions. Technical Engineers were able to take the information obtained from the verification process and optimize the PlumeStop and ORC Advanced design. The co-application of the two technologies quickly sorbed dissolved-phase contaminants and promoted aerobic biodegradation.

PlumeStop is comprised of very fine particles of activated carbon (1-2 μ m) suspended in water through the use of organic polymer dispersion chemistry. These features allow PlumeStop to travel through even the smallest soil pore throats during application without clogging and with the use of low pumping pressures. Once applied, PlumeStop begins to coat the surface of the soil forming a sorbent matrix where both an immediate reduction of dissolved phase contaminants and rapid biological destruction of contaminants are realized. The PlumeStop formulation used for this site included a soluble electron donor and bioaugmentation substrate to facilitate biologically-mediated destruction of the sorbed contaminants.

ORC Advanced is an engineered, oxygen release compound designed specifically for enhanced, in situ aerobic bioremediation of petroleum hydrocarbons in groundwater and saturated soils. Upon contact with groundwater, this calcium oxy-hydroxide based material becomes hydrated producing a controlled-release of molecular oxygen (17% by weight) for periods of up to 12 months on a single application. Oxygen is required by microorganisms to transform organic contaminants (such as petroleum hydrocarbons) into carbon dioxide, water and microbial cell mass. More importantly, the new and readily available oxygen produced by ORC Advanced accelerates aerobic biodegradation processes up to 100 times faster than natural degradation rates. ORC Advanced provides remediation practitioners with a significantly faster and highly effective means of treating petroleum contaminated sites.

Post Remediation Brownfield Discussion

Residual BTEX and TPH-d concentrations lingering for years are common for gas station sites and often are the only obstacle to closure. The combined remedies application of PlumeStop and ORC Advanced demonstrates a unique ability to attain non-detect levels in a short time frame with substantial cost savings over other approaches, including natural attenuation.



Injection

Following a design verification sampling and hydraulic pump testing event, the two technologies were applied during a single application event. Injection pressures remained below 5 psi for LAC and below 10 psi for calcium oxyhydroxide. Distribution of greater than 12 feet was also observed.



Results

Verification testing pre-site application allowed REGENESIS to make the appropriate recommendations and optimize the combined remedies approach and confirmed the design parameters, which was instrumental in leading to the success of the project, achieving quick and certain reductions in concentrations of BTEX and TPH.

The in situ groundwater treatment efforts resulted in reaching non-detect at all wells within 30 days of application- resulting in substantial cost-savings over other approaches including natural attenuation.

- Groundwater concentrations have remained at non-detect for over a year
- Post remediation soil sampling also indicated non-detect
- Site is up for an environmental covenant (based on another part of the plume from the former septic drainfield cavity having moved off-site under an adjacent road)







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Project site during injection activities



Project site during injection activities



Project site during injection activities