APPLICATIONS OF JETTING TECHNOLOGY FOR IN-SITU REMEDIATION

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Jetting technology using high-pressure, low to high volume injection of liquids into the subsurface using a small-diameter wand or lance driven into the subsurface has been widely used for several decades. Jetting technology, at its most basic, uses tree root feeder systems to inject liquids into the ground. The Remediation Injection Process (RIP®), an updated and more powerful, versatile and adaptable jetting delivery system has been used to efficiently implement, or augment, a variety of environmental remediation processes including chemical oxidation, bioremediation, pH adjustment and metals stabilization. The hand-held RIP™ lances have been designed to use high-pressure liquid pumps to increase flow at the tip of the wand to pressures exceeding 5,000 psi. At these pressures, the lances are driven downward at velocities up to one foot per second. High pressure injection points placed on close spacing, such as 2 foot centers to 5 foot centers, allows for complete in-situ coverage, vertically and laterally. Radius of influence around injection ports has been documented to exceed 10 feet.

Jetting technology is used to remediate limited access areas such as underneath slabs, railways, and buildings, around tanks, pipelines and subsurface utilities; and into hillsides, excavation pits and stockpiles. The flexibility and accuracy of this injection delivery system provides distinct advantages over both conventional in-situ and ex-situ remediation systems. Hot spots can be effectively treated using this technology. As a result, the jetting technology can provide appreciable savings in cost and time over traditional remediation technologies.

Jetting uses chemical oxidizers to rapidly treat soils contaminated with toxic and persistent organic wastes. The two most common oxidizers used for jetting in soil and groundwater remediation are hydrogen peroxide and potassium permanganate to treat petroleum hydrocarbons (such as gasoline, diesel, motor oil, and jet fuel), volatile organic compounds, munitions, certain pesticides and wood preservatives. Aerobic biological degradation and natural attenuation of fuel hydrocarbons and selected other organic compounds have been remediated by jetting using liquid oxidants, nutrients and other amendments. Under the correct subsurface conditions, soluble metals, such as arsenic and chromium, have been stabilized using sulfide compounds, converting the toxic metals into a low solubility sulfide. Alkalinity, pH, and organic content must be evaluated prior to any in-situ metals stabilization project. Injection ports are grouted with bentonite or neat cement. Case studies will be discussed summarizing the delivery capability in various soil conditions using oxidation and bioremediation technology featuring a variety of contaminants, including gasoline, diesel, tetrachlorethylene (PCE), trichloroethylene (TCE), dichloroethylene (DCE), and toluene.

RIPâ CASE STUDIES:

CASE STUDY # 1 - Based on previous site investigations, the soil and groundwater beneath a petroleum storage facility in northern California was found to be impacted with, free product consisting of TPH as diesel (TPH-d) and gasoline (TPH-g) range hydrocarbons. As part of a proposed pilot study, four soil borings were initially drilled using a direct push probe sampling rig. Soil samples were collected at 7 and 11 feet below ground surface (bgs) to provide pre-treatment data for the pilot scale test.

Groundwater samples were also collected as groundwater was encountered at about 7 feet bgs. The initial investigation detected free product, with concentrations of TPH-d as high as 6,500,000 micrograms per liter (µg/L) and TPH-g as high as 770,000 µg/L. The impacted soil extended to a maximum depth of approximately 15 feet bgs and generally consisted of fine sand, silts and clays.

Remediation Approach - The pilot study was designed to treat approximately 133 cubic yards or a 12-foot by 20-foot area. A grid pattern was established with 77 lance injection points spaced on 2 foot centers. After coring through the concrete and preparing the pilot study area, 495 gallons of 18% hydrogen peroxide were injected over 4.25 hours. The injection pressure at the lance tip ranged from 1,500 psi to 3,000 psi during the injection process.

Results - Significant reductions of diesel range hydrocarbons were found to occur in the groundwater. TPH-d was reduced in the groundwater from a maximum concentration of 6,500,000 µg/L prior to the injection treatment down to a maximum detected concentration of 4,700 µg/L following the oxidation process. No free product was detected after treatment. With only 4.25 hours of treatment, the overall average diesel concentration in the groundwater was reduced by greater than 99% and gasoline by greater than 50%.

CASE STUDY #2 - A manufacturing facility in Tumwater, Washington had soil contaminated with volatile organic compounds, including perchloroethylene (PCE), trichloroethylene (TCE), dichloroethylene (DCE) and toluene. The contaminants were reduced in the soil using high concentrations of hydrogen peroxide. The TCE, DCE and toluene were destroyed after one treatment event. Approximately 70 percent of the PCE in the soil was destroyed after two treatment events, enough to allow for site closure. The actual remediation cost was about eight percent of the alternative which was a dig and haul project with shoring, estimated to cost about $500,000. Regulatory objectives were met and site closure, property transfer and redevelopment were accomplished.

NOTES: RIP® is a trademark of Environmental Bio-Systems·

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