NAPL REMEDIATION

From Low-Permeability Soil

Client: Fortune 500 Company

Former Consumer Product Manufacturing Facility, Georgia

May – December 1999

Current Environmental Solutions (CES) used Six-Phase Heating (SPH) and multi-phase extraction to remediate a free-floating hydrocarbon plume beneath a former manufacturing facility in Georgia. The hydrocarbon, a specialty fuel similar to kerosene or diesel fuel, covered an area of 4,900 ft^2 and up to l0 ft thick.

SITE

SPH was chosen for site remediation because conventional product recovery methods, such as pump and treat and multi-phase extraction, have a limited ability to remove light non-aqueous phase liquids (LNAPL) from low-permeability soils.
Most of the LNAPL was located beneath a 100,000-ft^2 building. The soil from the building floor to a depth of about 50 ft was composed of highly heterogeneous sandy clay saprolite, with moderately low permeability. Groundwater was encountered at 24 ft below grade (bg). Initially the LNAPL, which floated on the groundwater, covered an area 4,900 ft^2 and was up to 10 ft thick, with most wells containing 1-3 ft of LNAPL.

TECHNOLOGY

SPH is emerging as a leading technology in difficult in-situ soil and groundwater remediation. It has proved an efficient, rapid means of remediating soil contaminated by volatile and semi-volatile organic contaminants.

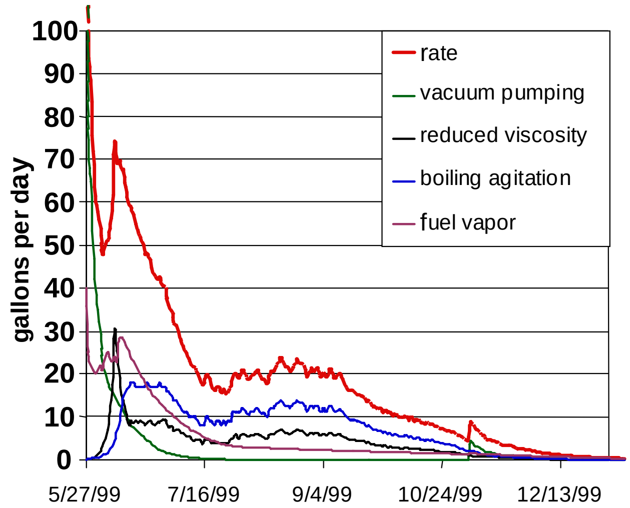
The technology was developed for the US Department of Energy at Pacific Northwest National Laboratories. CES has been applying the Battelle patents under a valid license since 1997. The only other licensee has experience in applying these patents just since January 2003, giving CES over five (5) years more experience than any other competitor.

SPH uses polyphase electricity to resistively heat the soil and groundwater to the boiling point of water. The heat increases the volatility and lowers the viscosity of the contaminants. Once steam is generated in situ, it acts as a carrier gas which strips out contaminants from the tight soil. The steam is collected from the subsurface by a soil vapor extraction process, and treated aboveground by conventional means, activated carbon, or catalytic oxidization.

WWW.CESIWEB.COM
TEL:(215)741-6123
FAX:(215)741-6124

APPLICATION

Remediation work began on May 27, 1999. Altogether, 50 combination extraction and monitoring wells and SPH electrodes were installed. The electrodes were designed to heat the soil from 20 to 30 ft bg.



SITE MONITORING DATA DURING HEATING

The remediation technology, as it was applied at this site, used several mechanisms to remove the hydrocarbon:
Heating of the ground reduced the viscosity of the hydrocarbon, making it amenable to multiphase extraction;
As the groundwater beneath the layer of LNAPL reached boiling point, rising bubbles of steam agitated the hydrocarbon and drove it towards the surface; Heating the ground also caused the LNAPL to boil, forming vapors which rose to the surface. Free product and vapors were extracted from the wells from 22 to 27 ft bg. The vapor was cooled in a condenser, and the steam was released to the atmosphere after a thermal oxidizer had destroyed the hydrocarbon vapors. An oil-water separator was used to remove separate-phase hydrocarbon from the condensed steam and extracted groundwater. Most of the liquid hydrocarbon was pumped to the oxidizer for destruction.

RESULTS

By December 10, 1999, after 6.5 months of SPH and multiphase extraction operations, the hydrocarbon plume had been reduced from a thickness of up to 10 ft to the remediation goal of less than 0.125 inches.

CONCLUSIONS

SPH achieved the site remediation goals by both increasing vapor pressure for enhanced vapor recovery and reducing product viscosity for pumping.

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