IN-SITU THERMAL DESORPTION OF SOILS Completed Project Results, and New Application for Treating MGP Waste

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ABSTRACT

In Situ Thermal Desorption (ISTD) is a soil remediation process in which heat and vacuum are applied simultaneously to subsurface soils. Heat flows into the soil primarily by conduction from heaters typically operated at 700-800°C. The heaters are installed in wells at regular intervals within the soil. As soil is heated, contaminants in the soil are vaporized or destroyed by several mechanisms, including evaporation, steam distillation, boiling, oxidation, and pyrolysis. The vaporized constituents are drawn toward extraction wells.

Compared to fluid injection processes, the conductive heating process during ISTD is very uniform in its vertical and horizontal sweep. The combined effectiveness of both heat and vapor flow leaves no area untreated. Laboratory treatability studies and field project experience from seven sites have confirmed that high temperatures applied over a period of days result in extremely high removal efficiency of even high boiling point contaminants such as PCBs, pesticides, and heavy hydrocarbons. Most of the contaminants are destroyed in the soil before reaching the surface. A summary of the results of completed ISTD projects are summarized in the following table:

LOCATION	CONTAMINANT	INITIAL CONCENTRATION (ppm)	FINAL CONCENTRATION (ppm)
S. Glens Falls, NY	PCB 1248/1254	5,000	< 0.8
Cape Girardeau, MO	PCB 1260	500	< 1
Cape Girardeau, MO	PCB1260	20,000	< 0.033
Mare Island , CA	PCB 1254/1260	2,200	< 0.033
Portland, IN	1,1 DCE	0.65	0.053
Portland, IN	PCE/TCE	3,500/79	< 0.5/0.02
Tanapag, Saipan	PCB 1254/1260	10,000	< 1
Eugene, OR	Gasoline/Diesel	3,500/9,300 + free product	N.D. benzene 250,000 # free product removed
Centerville Beach, CA	PCB 1254	800	< 0.17

At time of this presentation a manufactured gas plant (MGP) site is being treated using ISTD. To aid in the prediction of rate of ISTD treatment and optimum spacing of heater and vacuum well configuration, a simulation modeling effort was performed. Modeling results are presented.

They illustrate the importance of in situ oxidation and pyrolysis in reducing the required duration and cost of ISTD treatment. Simulations were conducted as a predictive tools for the desorption and destruction of town-gas residues containing up to 61,000 ppm of polycyclic aromatic hydrocarbons. Unique aspects of the problems at the site include, areas of concentrated free tar, significant amounts buried debris, and a water table that is shallower than most of the contamination.

The simulations demonstrate the following. First, the benzo (a) pyrene can be desorbed from this very wet site using a 9:1 heater to heater-vacuum well pattern with 7.5 feet between heater wells in about 120 days of heating. Secondly, pumping water from under the treatment zone accelerates the cleanup significantly, and can reduce the amount of energy required to clean the site by 40-60%. Thirdly, destruction reactions like coking; oxidation and shift reactions release enough energy and decompose enough contaminant to reduce the cleanup time to about 100 days of heating. Essentially all of the benzo (a) pyrene will be decomposed before it reaches the surface, although a few percent of the more volatile components of the tar may survive the in situ destruction reactions, requiring a thermal oxidizer at the surface. Additionally, the contaminants in 9:1 heater to heater-vacuum well patterns with 6 foot spacing between wells could be desorbed and destroyed about 30 days faster than the 7.5 foot patterns. Finally, the patterns at the edge of the treatment zone could loose enough energy to the surroundings to delay reaching decomposition temperatures. This can be offset by extending insulation farther beyond the treatment zone and increasing the air supply to enhance exothermic oxidation reactions.

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