OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY
FACT SHEET

HotPoint DNAPL Soil Gas-Phase Sampler

In Situ Radio Frequency Soil Heating Aids Trichloroethylene Detection

Environmental Problem Addressed

The targeted problem for this project is the characterization of sites with Dense Non-Aqueous Phase Liquid (DNAPL) contamination in unsaturated soil or rock. Present site characterization technology to measure the spatial distribution of common DNAPL contaminants (tri- and/or per-chloroethylene) has significant limitations, particularly for in situ characterization and post-remediation verification monitoring. Many DOE sites have high-cost baselines for TCE characterization as well as high-risk baselines for cleanup because of the uncertainty of TCE site spatial distribution. At ambient soil and groundwater temperatures (5-20°C), water-filled soil porosity can obstruct gas phase transport to any in situ sampler and TCE's low vapor pressure limits the sensitivity of in situ gas analyses to the soil voids in direct proximity to any penetrometer probe. Thus, significant amounts of TCE near an in situ sampling probe can easily be missed resulting in poor confidence in site characterization data.when using cone penetrometer technology (CPT) for soil gas sampling under ambient conditions. Attempts to overcome this limitation by heating soil around a heated probe also have significant limitations imposed by the low thermal conductivity of soil.

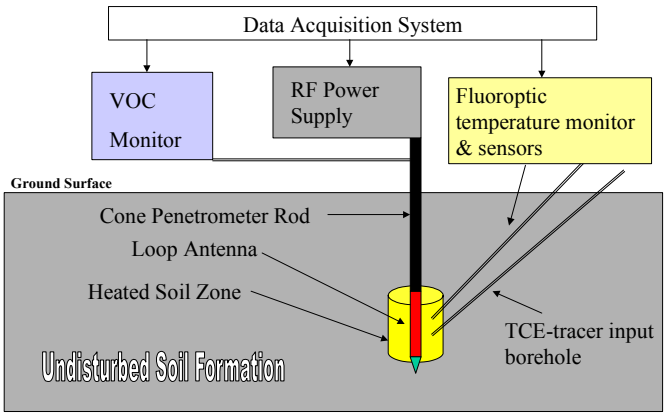
HotPoint Concept

These limitations of gas sampling can be overcome by rapid in situ soil heating around a CPT sampling point by transmitting radio-frequency energy into the surrounding soil to generate heat in situ; thereby, a significant volume of soil (i.e., 10-20 L) can be warmed to at least 73°C (the TCE-water mixed boiling point at standard atmospheric pressure) so that most, if not all, of the TCE contained in the heated volume will be available to CPT sampling. The primary objective of this project was to establish proof-of-principle that a 10-20 L volume of soil can be heated from ambient temperature to 73°C in a relatively short interval (20 min).

Accomplishments

- Demonstrate a field-scale RF-power delivery system, with in-line impedance matching circuitry for antenna loading coupled within a standard-size cone penetrometer drill rod train.
- Demonstrate heating of an undisturbed 20-liter soil volume at least two feet below ground surface from ambient temperature (15-20ºC) to ≥ 75ºC in less than 20 minutes of 3-kw applied power at 27.12 MHz.

Field-Scale In Situ Soil Heating Test Configuration



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