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SITE
SUPERFUND INNOVATIVE
TECHNOLOGY EVALUATION

Demonstration Bulletin

Terra-Kleen Solvent Extraction Technology

Terra-Kleen Response Group, Inc.

Technology Description: The Terra-Kleen Solvent Extraction Technology was developed by Terra-Kleen Response Group, Inc., to remove polychlorinated biphenyls (PCB) and other organic constituents from contaminated soil. This batch process system uses a proprietary solvent at ambient temperatures to treat the contaminated soil. The system includes a solvent regeneration system that concentrates the extracted contaminants and allows the extracted solvent to be reused. Following treatment, clean soils are returned to the site, and the concentrated contaminant is sent off site for disposal.

A schematic diagram of the pilot-scale treatment system that was used in the Superfund Innovative Technology Evaluation (SITE) demonstration is shown in Figure 1. The system includes the following equipment: five extraction tanks (tanks A through E), a sedimentation tank, a microfiltration unit, a solvent purification station, a clean solvent storage tank, and a vacuum extraction system. Since the solvent used is flammable, pneumatic, and spark-proof pumping systems are used to move the solvent and vapor through the system, thus maintaining an intrinsically safe environment.

Treatment begins after the excavated soil is loaded into the extraction tanks. Screening of solids is not necessary, but may be advantageous when large rocks and/or debris are present. Clean solvent from the solvent storage tank is then pumped into the extraction tanks. The soil and solvent are held in the extraction tank for a time period sufficient to solubilize organic contaminants, separating them from the soil. The contaminant-laden solvent is then transferred from the extraction tank into the sedimentation tank. Clarified solvent is pumped to the micro-

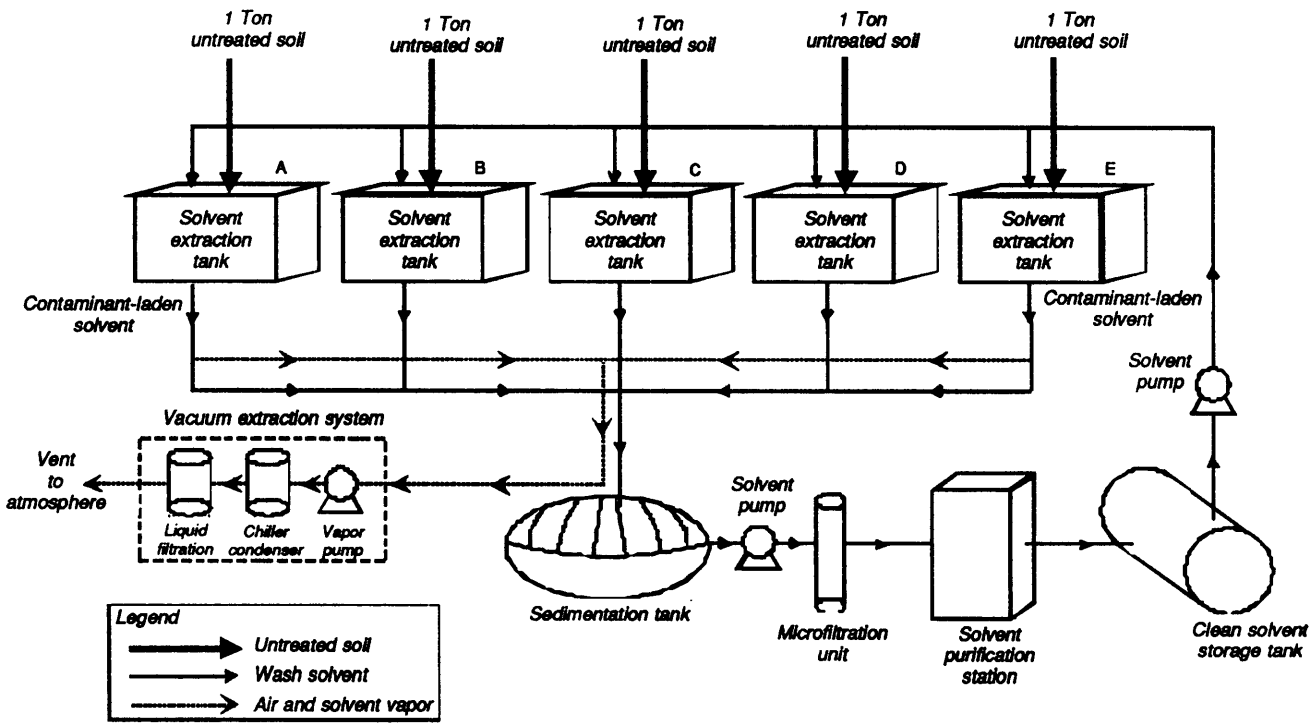

Figure 1. *The Terra-Kleen solvent extraction technology as demonstrated.*

filtration unit and the solvent purification station prior to recycling. Solvent wash cycles are continued until a site-specific soil cleanup level is attained.

Some residual solvent remains in the soil after the wash cycles are completed. Vacuum extraction is used to remove the majority of the residual solvent by drawing solvent vapor through a condenser and liquid filter. Following vapor extraction, an active biological culture is added to the treated soil to biodegrade any remaining residual solvent. Finally, the treated soils are removed from the extraction tanks.

The solvent regeneration process begins by pumping contaminant-laden solvent from the sedimentation tank through a microfiltration unit and a proprietary solvent purification station. The microfiltration unit removes any fines remaining in the solvent. The solvent purification station separates organic contaminants from the solvent and concentrates them, reducing the volume of hazardous waste for offsite disposal. The regenerated solvent is then pumped into the clean solvent storage tank for use in subsequent wash cycles.

Waste Applicability: The Terra-Kleen solvent extraction technology is a volume reduction process designed to remove semivolatile and volatile organic contaminants from soils, specifically: PCBs, petroleum hydrocarbons, chlorinated hydrocarbons, polycyclic aromatic hydrocarbons, polychlorinated dibenzo-p-dioxins (PCDD), pesticides, and polychlorinated dibenzo-p-furans (PCDF).

The system is transportable and can be configured to treat small volumes of soil (1-1,000 yd^3). Multiple large extraction tanks (20 yd^3) can be used to treat higher volumes of contaminated soils. The technology's effectiveness for removing pesticides from soil is currently under investigation.

Preliminary Results: Terra-Kleen demonstrated its solvent extraction technology during a SITE demonstration between May 16 and June 11, 1994. The technology demonstrated was at Naval Air Station North Island's (NASNI) Site 4, which is located near San Diego, California. As part of the Naval Environmental Leadership Program (NELP), NASNI contracted with Terra-Kleen to treat approximately five tons of PCB contaminated soil.

Terra-Kleen conducted 11 washing cycles in seven days. Analytical results showed that the only PCB mixture present in the soil was Aroclor 1260. Table 1 shows the analytical results of soil samples collected from each extraction tank. These analysis were conducted on-site and are preliminary. Additional data quality checks are being completed on laboratory generated values.

Table 1. *Preliminary PCB Removal Results for the Terra-Kleen SITE Demonstration at Naval Air Station North Island*

	PCB as Aroclor 1260 in milligrams per kilogram (mg/kg)				
Extraction Tank	*Tank A*	*Tank B*	*Tank C*	*Tank D*	*Tank E*
Untreated Soil	*130*	*140*	*134*	*147*	*170*
Treated Soil	*1.34*	*1.57*	*1.66*	*2.64*	*1.41*
Percent Removal	*99.0*	*98.9*	*98.8*	*98.2*	*99.2*

To provide additional information on the technology's capabilities, samples were also collected and analyzed for volatile and semivolatile organic compounds, PCDD, and PCDF. These analytical results and the Terra-Kleen SITE demonstration findings will be discussed in the SITE technology capsule and the innovative technology evaluation report. Preliminary findings from this SITE demonstration are summarized as follows:

- PCB Aroclor 1260 concentrations were reduced from an average of 144 milligrams per kilogram (mg/kg) in untreated soil to an average of 1.72 mg/kg in treated soil. The average removal efficiency was 98.8%.
- The system can effectively concentrate PCBs into a smaller waste volume for offsite disposal.
- The treatment system's PCB removal efficiency was consistently reproduced for all five batches treated during this demonstration.

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