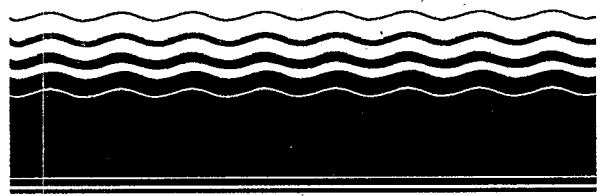




SITE

SUPERFUND INNOVATIVE
TECHNOLOGY EVALUATION



Demonstration Bulletin

BiogenesisSM Soil Washing Technology

BiogenesisTM

Technology Description: The BiogenesisSM soil washing technology was developed by BioGenesis Enterprises, Inc. to remove organic compounds from soil. The technology uses a proprietary solution (BioGenesisSM cleaner) to transfer organic compounds from the soil matrix to a liquid phase. BioGenesis claims that this treatment process can be used onsite; generates treated air; generates treatable water; and soil suitable for onsite backfill. Because the BioGenesisSM cleaner, a complex blend of surfactants, is rapidly degraded by soil microbes, the cleaner and contaminant-rich wastewater generated during the process can be biodegraded in a bioreactor. Moreover, residual BioGenesisSM solution on the soil particles stimulates the biodegradation of soil contaminants not removed by the washing process.

A schematic diagram of the BiogenesisSM treatment system is shown in Figure 1. The BiogenesisSM treatment unit used for the Superfund Innovative Technology Evaluation (SITE) technology demonstration at a Refinery site included the soil washing unit fitted with an oil skimmer, a baffle filter, and an air compressor. Support equipment, such as an American Petroleum Institute (API) oil-water separator, oil coalescer, holding tanks, and bioreactor, was not used during the Refinery site demonstration. The water used for soil washing was supplied by the Refinery and was not recycled. Steam was used by the Refinery to raise the temperature of the washwater to 60°C prior to its introduction

into the wash unit. Wastewater from the soil wash unit was pumped to the Refinery's wastewater treatment system, which is equipped with oil-water separators.

During the treatment process, the BiogenesisSM system pumps approximately 1,000 gal of water into the wash unit and loads it with as much as 20 yd³ of soil. After the wash unit is loaded, three mechanical shakers on each side of the wash unit are used to agitate the soil and water mixture. Next, additional water (about 1,500 gal) and approximately 8 gal of BioGenesisSM cleaner are pumped into the wash unit. The resulting slurry is agitated by the shaker and a series of aerators that are in the bottom of the wash unit. After the slurry is sufficiently mixed, additional water (approximately 500 gal) is added to raise the fluid level, allowing floating oil product to flow out of screened ports on the side of the unit. Once the floating product is removed, the soil is agitated again.

When agitation is complete, the fluid level is raised again and floating oil product is removed from the system. Valves in the bottom of the wash unit are then opened, and contaminated wastewater is drained from the wash unit. Because no bioreactor was used as part of the demonstration at the Refinery site, the contaminated wastewater was pumped to the Refinery's wastewater treatment system. Refinery personnel were responsible for

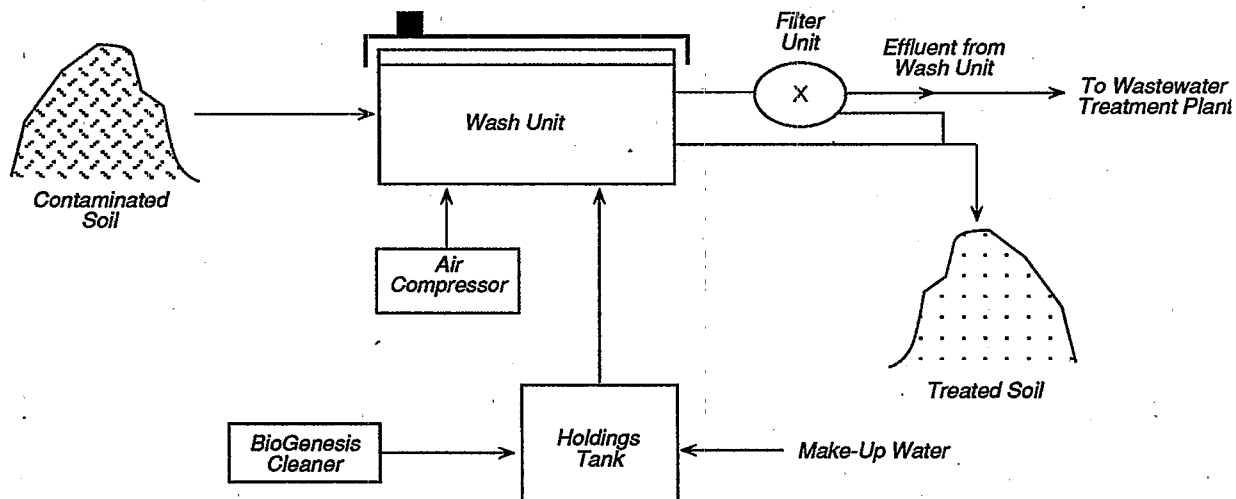


Figure 1. BiogenesisTM soil washing process.

the disposal or recycling of treated waters and recovered oil. The BioGenesisSM soil washing technology was tested at a site in Santa Maria, California prior to the demonstration at the Refinery site to determine optimum process parameters such as, mixing time, number of washes, and BioGenesisSM cleaner dose. Results from the Santa Maria site indicated that the amount of contamination removed from soils can be increased by repeated washing. Therefore, once the wash unit was drained, the process of adding water and BioGenesisSM cleaner and agitating the soil was repeated. Treated soil was then removed from the washing unit, drained of wastewater, and placed in a holding area for sampling.

Waste Applicability: BioGenesis claims the following for the BioGenesisSM process:

- The process is capable of extracting volatile and nonvolatile hydrocarbons, including petroleum hydrocarbons, chlorinated hydrocarbons, pesticides, polychlorinated biphenyls (PCB), and polycyclic aromatic hydrocarbons (PAH) from most soils, including clays.
- The process can treat soils and sludge contaminated with petroleum hydrocarbons at levels up to 50% oil.
- The prototype transportable wash unit and support equipment can treat 25 to 35 tons of soil per hour. Succeeding production units will treat up to 70 ton/ hr.
- For heavy crude oil contamination in cold climates, the prototype unit removes 70% to 85% of the hydrocarbon contamination with washing. For lighter contaminants such as gasoline or diesel, and depending upon contaminant concentration, the process cleans from 85% to 98% with washing alone.
- Residual contaminants in soil and wastewater are further removed by biodegradation.

Demonstration Results: The BioGenesisSM soil washing technology was demonstrated at the Refinery site in a series of three runs over a 2-day period in November 1992. The Refinery contracted BioGenesisSM to treat approximately 2,000 yd³ (3,800 tons) of soil that was contaminated with petroleum hydrocarbons (heavy crude oil). Analytical results from a sample collected from the

untreated soil prior to the demonstration revealed total recoverable petroleum hydrocarbon (TRPH) concentration of 30,800 ppm, and trace levels of benzene, toluene, ethylbenzene, and xylene (BTEX). Because TRPH was detected at relatively high concentrations, it was selected as the contaminant group of concern for the demonstration.

EPA collected samples from treated and untreated soil, water, and wastewater. EPA collected two buckets of treated soil and kept the buckets at a temperature of 20°C. EPA collected samples on the 14th, 40th, 60th, and 90th day following the field demonstration to determine the effect of biodegradation on TRPH concentrations. Additional samples will be collected on the 120th and 180th day. Process operating data were collected during the demonstration to document process operating conditions.

The analytical data from all the samples are not yet available. Key findings of the SITE demonstration, including sample analytical results, will be discussed in the SITE technology capsule and the innovative technology evaluation report. During the SITE demonstration at the Refinery, the following preliminary findings were noted:

- Soil washing and biodegradation with BioGenesisSM removed about 85% of the TRPH-related contaminants in the soil.
- The treatment systems performance was reproducible at constant operating conditions.
- At the end of 90 days, TRPH concentrations have decreased an additional 50% compared to washing alone. Sampling to determine extent of biodegradation will continue.
- BioGenesis indicated that the prototype equipment operated within design parameters. New production equipment is expected to streamline overall operating efficiency.

For Further Information:

Annette Gatchett
U.S. EPA Risk Reduction Engineering Laboratory
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7697 (FAX: 569-7620)

*U.S. Government Printing Office: 1993 — 750-071/80013

United States
Environmental Protection Agency
Center for Environmental Research Information
Cincinnati, OH 45268

Official Business
Penalty for Private Use
\$300

EPA/540/MR-93/510

BULK RATE
POSTAGE & FEES PAID
EPA
PERMIT No. G-35