



# TechData Sheet

Naval Facilities Engineering Service Center  
Port Hueneme, California 93043-4370



TDS-(INTERIM)-2070-ENV

October 1999

*Ex-Situ Bioremediation of Heavy Petroleum Hydrocarbons in Soils at NFD Pt Molate*

## A Demonstration of Facultative Bioremediation

Conducted by: **Industrial Ecosystems Inc., Pacifica, CA**

In cooperation with: **Bay Area Defense Conversion Action Team Environmental Technology Partnership**

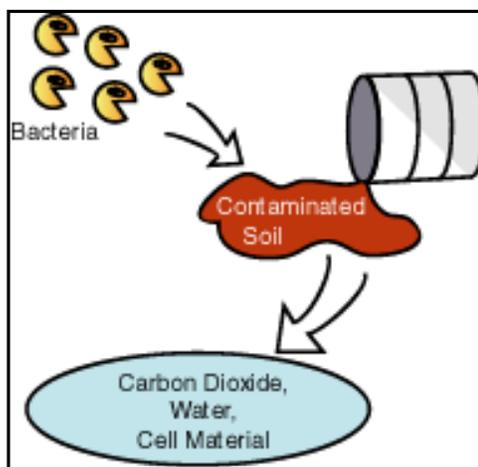
### Introduction

Industrial Ecosystems, Inc. (IEI) is performing an enhanced bioremediation demonstration project at Naval Fuel Depot (NFD) Point Molate, CA. This project is conducted under the Bay Area Defense Conversion Action Team Environmental Technology Partnership (BADCAT ETP). BADCAT ETP is a public/private partnership of the Bay Area Regional Technology Alliance, California Environmental Protection Agency, San Francisco State University CAREER/PRO, U.S. Environmental Protection Agency, U.S. Navy, Chevron and other experts working together to expedite the cleanup and conversion of closing military bases in the San Francisco Bay Area through the application of innovative environmental technologies.

NFD Point Molate is located along the eastern shore of San Francisco Bay adjacent to the city of Richmond. Diesel fuel and heavy fuel oil, such as Bunker C, are present at the Treatment Ponds site. The total petroleum hydrocarbon (TPH) concentration is about 47,000 parts per million (ppm). Unlike gasoline, diesel and oil fuels are not very volatile and contain only low levels of benzene, toluene, ethylbenzene and xylene compounds.

Bioremediation uses bacteria to consume and breakdown hydrocarbon contaminants in the soil. The end products of this process are carbon dioxide, water, and non-hazardous cell material. After the hydrocarbons are consumed, the bacteria population will naturally decline as their food supply diminishes.

Typically, bioremediation only works with oxygen. IEI's proprietary process uses facultative bacteria to accelerate the bioremediation process on fuels and heavy oils. IEI's unique *facultative* process is engineered to work with *and* without oxygen.



*Natural bioremediation process*

### Advantages of IEI's Process

**Quicker** – Three to five times faster than traditional bioremediation. A cleanup project can take between 60 and 120 days.

**Contaminant types** – Remediates gasoline, diesel, aviation fuel, heavy oil, asphaltene, and crude oil.

**Permanent solution** – Permanently converts contaminants to non-hazardous substances, resulting in clean soil. Traditional disposal of contaminated soil at landfills merely transfers the problem and retains generator liability.

**Simple logistics** – Treatment cells consist of a polyethylene liner placed over hay bales. Cells can be quickly and easily constructed at or near the site. Treatment operations do not require public utilities nor long distance hauling logistics.

**Limitations of IEI's process:**

**Surface area** – The process needs a large area to set up and operate. This demonstration requires an area of about 30 feet by 15 feet for the treatment cell.

**Leachate control** – Leachate must be monitored and controlled with collection barriers.

**Contaminant type** – Metals cannot be treated by this bioremediation process. The ability of this process to treat PCBs, chlorinated solvents and pesticides is unknown.

**Field Demonstration**

The demonstration project is designed to reduce 47,000 ppm of TPH in soil to less than 1,000 ppm. This clean-up goal is typically within regulatory acceptance levels. Demonstration steps include:

- Excavate 40 cubic yards of contaminated soil.
- Place soil into a lined and bermed treatment cell (see photo) about 350 feet away from excavation area.
- Add a propriety mixture of microbes, nutrients and additives into the soil.
- Turn the soil monthly.
- Analyze soil TPH contaminant concentration monthly. Monitor soil acidity, salinity, moisture, temperature and particle size distribution for process control.



*Contaminated soil being placed into a treatment cell*

This project started in June 1999 and is scheduled to be completed in October 1999. We plan to issue a final Tech Data Sheet in March 2000 to summarize the final results.

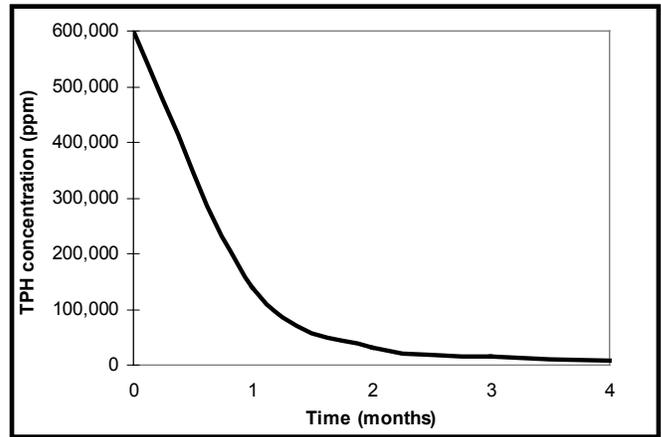
**Cost Effectiveness**

Facultative bioremediation is a cost effective clean up method identified for treating fuels and oils. IEI treated soil at over 500 sites with this process, and their data shows that a full scale application of their facultative bioremediation process costs about \$30 per ton of soil. *Civil Engineer* (May 1995) estimates on-site bioremediation costs 30% to 40%

less than thermal desorption treatment. For soils with over 30,000 ppm of TPH contamination, traditional excavation and disposal at a landfill could cost over \$100 per ton. With IEI's on-site process, long haul transportation costs to a disposal facility are eliminated. In addition, soil treated with IEI's process can be placed back into the original excavated site, eliminating the cost for purchase and transport of clean soil for backfill.

**Case Studies**

In Santa Maria, CA, IEI remediated 500 cubic yards of soil with a TPH concentration of 58,000 ppm to 230 ppm in 9 weeks. The CA Regional Water Quality Control Board allowed this cleaned soil for use as top soil at the site. Also, the process remediated 25 drums of sludge from tank bottoms by reducing concentrations of TPH from 620,000 ppm to 600 ppm in 4 months for the Oil and Natural Gas Corp. of India.



*Results from an IEI project in India (Uran Oil Complex)*

*For more information, please contact:*

Navy (NFESC)  
(805) 982-2631

Navy (EFA West)  
(650) 244-2539

Industrial Ecosystems, Inc  
(650) 355-4050

BADCAT ETP Coordinator  
(510) 986-0303