

# Ivey International Inc.

"Today's Environmental Solutions For A Better Tomorrow"®

## Ivey-sol® Surfactant Enhanced Soil Washing Technology Overview and Project Experience

Ivey-sol® soil washing is an ex-situ surfactant enhanced remediation (SER®) treatment method which removes hazardous substances from contaminated soils, solids, tank bottom sludge, drill cuttings, drilling muds, etc. The soil washing process (Photo1) involves the introduction of the contaminated solids into a treatment chamber which contains an Ivey-sol® formulation and water, at a specified ratio. The solids are then mixed or agitated to ensure effective contact between Ivey-sol® products and the absorbed 'surface bound' oil contaminants. Upon contact, the Ivey-sol® surfactants liberate the contaminants off of the solids into the water phase (Photo 2). Following treatment, the solids and water are easily separated to yield clean solids (Photo 3), which can be re-used on-site, and a liquid effluent from which the oil can be recovered. The subsequent liquid effluent can then be further treated by conventional oil and water separation, reducing the clean water system requirements.



Photo 1: Soil Washing System with Oil and Water Recovery

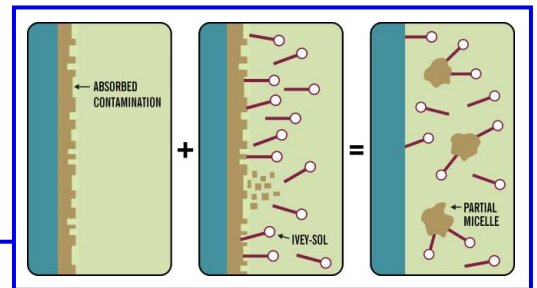


Photo 2: Ivey-sol® Mechanism for desorbing oils from solids



Photo 3: 5% Impacted Soils Pre and Post Ivey-sol® Treatment

## Project Experience

### Refinery Site (>5000 Tons)

Contaminated soil with a baseline concentration of 40,000 ppm (4%). Ex-situ Ivey-sol® Soil Washing SER® Process achieved applicable soil remediation site objectives. Project data set provided below showing pre and post soil washing remediation results with time based sample analysis.

SOIL PARAMETER	BASE LINE	5 MINUTES	7 MINUTES	% REDUCTIONS
F1 C6-10	72 ppm	< 1 ppm	< 1 ppm	100%
F1 BTEX	71 ppm	< 1 ppm	< 1 ppm	100%
F2 C10-16	417 ppm	35 ppm	21 ppm	95%
F3 C16-34	13,600 ppm	1,600 ppm	826 ppm	94%
F4 C34-50	5,060 ppm	512 ppm	259 ppm	95%
F4 C34-50+	13,000 ppm	571 ppm	290 ppm	98%

### Waste Oil Contaminated Site (>1000 Tons)

Contaminated soil with a baseline mid-range hydrocarbon concentration of 4,500 ppm. Ex-situ Ivey-sol® Soil Washing SER® Process exceeded applicable soil remediation site objectives for the commercial site. Table reveals time based treatment results and performance.

SOIL PARAMETER	BASE LINE	5 MINUTES	7 MINUTES	% REDUCTIONS
VH C6-10	2 ppm	< 2 ppm	< 2 ppm	100%
VH C6-10 (minus)	< 2 ppm	< 2 ppm	< 2 ppm	100%
LEPHs C10-19	191 ppm	191 ppm	46 ppm	76%
HEPHs C19-32	4,430 ppm	1,690 ppm	446 ppm	90%
VPH	< 2 ppm	< 2 ppm	< 2 ppm	100%

Note: VH = Volatile Hydrocarbons  
LEPH = Light Extractable Hydrocarbons  
HEPH = Heavy Extractable Hydrocarbons  
VPH = Volatile Petroleum Hydrocarbons  
(From BC Environment Soil and Water Clean-up Guidelines)

### Oil and Gas Project Site (<500 Tons)

This South American pilot project involved the soil washing (Photo 1) of <500 tons of oil and gas waste impacted soil and tank bottom sludges with concentrations between 6% to 14% to below the regulatory clean-up objective of <1%. Post treated soils were actually <0.5%, and the liberated oils were recovered, and the water was treated for reuse.

