

REMEDIATION SOLUTION



Ivey-sol™
Surfactant Technology
SER™, SEB™, and SEC™

PROCESS DESCRIPTION

During in-situ and ex-situ remediation of contaminated soil or water the greatest limiting factor for all forms of remediation is contaminant sorption (i.e., absorption and or adsorption). If we can overcome contaminant sorption, we can significantly improve all forms of soil and water remediation, reducing the treatment costs and duration. Also very effective for vapour suppress of volatile petroleum hydrocarbons during soil excavation.

Ivey-sol® Surfactant Technology is comprised of several patented and preparatory non-ionic surfactant formulations that have the unique ability to selectively desorb and liberate sorbed (i.e., absorbed and adsorbed) petroleum hydrocarbons (LNAPL), chlorinated solvents (DNAPL), and certain heavy metal contaminants from soil and fractured bedrock surfaces. The addition of Ivey-sol® to the substrate can aid in the controlled de-sorption of the contaminants making them more 'available' for treatment. Ivey-sol® makes the contaminants more miscible in the aqueous phase allowing for their improved mass recovery and/or improved treatment by many other remediation techniques. Three Ivey-sol® application processes were developed for enhancing in-situ and ex-situ air, soil and groundwater site remediation. They are as follows:

SER™ Surfactant Enhanced Remediation. In-situ and ex-situ application processes to liberate contaminants making them more 'hydraulically-available' for mass removal and/or treatment. SER™ improves in-situ pump and treatment, and/or ex-situ soil washing type applications by >400%. This process could also be used for tank cleaning, vapour suppression, and oil recovery from oil sands or shale oil.

SEB™ Surfactant Enhanced Bioremediation. In-situ and ex-situ application processes to liberate contaminants making them more 'bio-available' for microbial (bacteria) degradation. SEB™ improves both in-situ and/or ex-situ bioremediation treatment by 40 to 60% or more. Applicable for both warm and cold temperature/climate site applications.

SEC™ Surfactant Enhanced Chemicalization. In-situ and ex-situ application processes to liberate contaminants making them more 'chemically-available' for chemical degradation by REDOX reagents. SEC™ improves the availability of the contaminants to the chemical reagents commonly employed to affect in-situ and or ex-situ chemical degradation by 40 to 80% or more. The oxidation of non-target compounds (i.e., metals, natural products, and bacteria) is the greatest drawback to chemical oxidant treatment. Ivey-sol® helps overcome this limitation by increasing contact between contaminants and the chemical reagents used, improving the associated degradation rate of target compounds. This process may also be modified for application with chemical reducing agents in reductive dechlorination.

APPLICATIONS

The sorption of contaminants onto solids (i.e., soil, sediments, bedrock, sludge, drilling cuttings, oil sands and oil-shale) is considered the principal limiting factor in the effectiveness of most treatment technologies. This coupled with complex chemistry, geology and hydrogeology only further complicates matters.

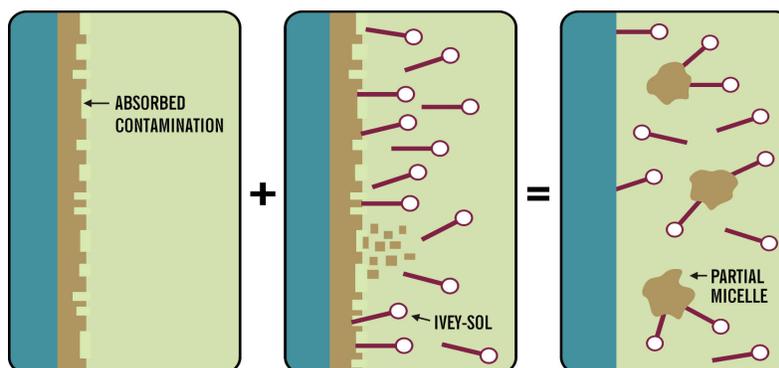
When HOC (hydrophobic organic compounds) like petroleum product, are absorbed on a soil grain, water alone will not remove it from the surface. This is a function of the hydrophobic characteristics of the HOC, which repels the water at its surface and its inherent low water solubility. With the addition of Ivey-sol[®] surfactants, the Ivey-sol[®] hydrophobic grouping is repelled by the water but attracted to the HOC on the surface. At the same time, the Ivey-sol[®] hydrophilic grouping is attracted to the water molecules. These opposing forces loosen the HOC from the surface of the soil matrix and suspend it in the water phase. Once dissolved, the suspended HOC is more 'hydraulically-available' for Pump and Treatment (P&T), more 'bio-available' to the microbial population present, and more 'chemically-available' for oxidation or reduction reactions. Once liberated in low concentration in a 'surfactant-aqueous HOC' microscopic outward appearance, it is more 'available' for treatment by most, if not all, forms of in-situ and ex-situ remediation treatment technologies.

Surfactant enhanced remediation involves the use of surfactant formulations to selectively desorb and dissolve target contaminants from the solid to liquid phase. In addition, the surfactants lower the surface tension of water from 72 dynes to <30 dynes increasing the wetting and permeability properties of water in fine grain soil (i.e., clay and silt) and bedrock fractures. The surfactants affect the sorption of HOC at the solid-liquid interface (i.e., the surface-H₂O-NAPL interface). As a result, the surfactants increase the contaminate miscibility and improved 'availability' for rapid and cost effective treatment.

Market Applications (General): Petroleum (Oil & Gas) Industry, Chemical and Petrochemical, Utility and Energy, Commercial and Industrial Manufacturing, Government, Real Estate Development, Industrial Cleaning, Free Product Removal and Green Technology and Sustainable Environmental Initiatives etc.

Market Applications (Specific): Air, Soil and Water Remediation, Oil Recovery (Oil Sands), Tank Cleaning, Bioremediation (In-situ and Ex-situ), Waste Water Treatment, Pump and Treatment, Improving Chemical Oxidation, Off-shore Spill Dispersant, Shoreline Clean-up, Vapour Suppression, Soil Washing, Degreaser, Biodegradable Solvent/Cleaner, etc.

Mechanism



Ivey-sol[®] shown desorbing contamination off a surface. Once liberated the desorbed contaminants have increased 'availability' for improving the associated in-situ and/or ex-situ remediation method being employed.

ADVANTAGES

Advantages and Effectiveness of Ivey-sol[®] products:

- i) They are non-toxic and biodegradable, so they do not persist in the environment after application;
- ii) Improves contaminant mass recovery for in-situ Pump and Treatment (P&T) by >400 to 800% or more, for LNAPL and DNAPL contamination;
- iii) Improves in-situ and ex-situ soil and water bioremediation by 40 to 60% or more;
- iv) Improves chemical oxidation by 40% to 80%, and reduces the mass of oxidant required and associated treatment period;
- v) Does not negatively affect water treatment systems (i.e., O/W Separators, GAC, Air Stripping, Membrane Separation, Bio-reactors, etc.).
- vi) Non-toxic to bacteria, so it can aid and/or improve natural attenuation;
- vii) Reduces required treatment times when used in conjunction with other remediation technologies (i.e., Pump and Treat, Bioremediation, Chemical REDOX, etc.);
- viii) Works well with dual phase extraction, vacuum extraction, and conventional P&T;
- ix) Works well in fine grain soils (i.e., silty sand, silt, silty clay, clay and fractured bedrock);
- x) Does not generate additional operation and maintenance (O&M) issues;
- xi) Applicable for the full range of LNAPLs, has been demonstrated to be very effective on most DNAPL contaminants, and several heavy metals;
- xii) Can be applied to saturated and/or unsaturated zone; and
- xiii) Works well with other in-situ and ex-situ remediation technologies (1+1=3).

ENVIRONMENTAL BENEFITS

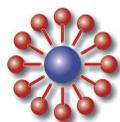
- Improves all forms of in-situ and ex-situ air, soil, sediment, water remediation technologies.
- Achieves rapid and cost effective pollution destruction with low concentration applications.
- Effective for Petroleum Hydrocarbons, Chlorinated Compounds, Pesticides, and Organo-Metallics, etc..
- Biodegradable and does not persist in environment after use.
- Effective for vapour (VOC) suppression during soil excavation and procession and storage.

COSTS

Typical costs savings for in-situ and ex-situ applications typically range between 25 to 50% or more over many alternative remediation options. The actual costs (in-situ/ex-situ) will vary depending on soil type, concentration and type of contamination, site conditions, available resources, and the regulatory clean-up objectives to be achieved. Significant time savings given most in-situ P&T sites would take 5 to 7 years to remediate, but with Ivey-sol[®] are usually complete in less than 1 to 1 1/2 years.

EFFECTIVENESS

Effective for treating and improving remediation of Petroleum Hydrocarbons (Gasoline, Diesel, Lubricants, Bunker-C, Crude-oil), Chlorinated Compounds (PCB, PCP, CET, PET), Pesticides and Herbicides, Organo-metallics (Tetra-ethyl lead), and NORM (Naturally Occurring Radioactive Materials).



Ivey International Inc.

“Today’s Environmental Solutions For A Better Tomorrow”

COMPANY PROFILE

Ivey International Inc. is an international award winning environmental technology company with a commitment to provide outstanding products and services through the development and application of innovative air, soil and groundwater remediation technology. Ivey International Inc. specializes in remediation technology development and provision to environmental consultants, environmental contractors and oil and gas companies.

Sorption (absorption and/or adsorption) of contamination to soil, bedrock and/or solid waste is the #1 reason most forms of remediation are slow, costly and/or fail. Ivey International Inc. has developed the Ivey-sol[®] Remediation Technology to overcome this limitation. As a result, we are able to clean up contaminated soil, bedrock, solid waste, water, groundwater and oil and gas wastes more rapidly and economically.

The Ivey-sol[®] Surfactant Remediation Technology can selectively desorb contamination, including: petroleum hydrocarbons, chlorinated solvents and heavy metals. In doing so, Ivey-sol[®] liberates these sorbed contaminants from solid substrates making them more 'hydraulically available' for extraction by pump and treatment (P&T), more 'biologically available' for bioremediation (in-situ and ex-situ), and more 'chemically available' for elimination by chemical oxidation or chemical reduction. Ivey-sol[®] case studies and client references are available upon request.

Ivey-sol[®] has several commercial and industrial applications including: soil and groundwater remediation, bioremediation, tank cleaning, vapour suppression, NORMs treatment, frac-sand treatment, and marine oil-spill clean-up, among other applications.

On average, greater than 90 to 95% of small to medium size contaminated sites are remediated (In-situ) in less than 12 months. While our ex-situ process can take just hours or weeks depending on the Ivey-sol[®] treatment method and contaminants treated.

The Ivey-sol[®] products and processes have established a strong international reputation for rapid site remediation and reclamation, with significant time and cost savings for our project partners and clients. Our corporate mission is to be *"Today's Environmental Solutions For A Better Tomorrow"*[®].

National and International Awards received over the past few years include:

2011:

- MISTIC Award For Environmental Excellence;
- The Roy F. Weston Award. In recognition to contributions to the field of solid waste technology and management.

2008:

- The 2007 Environmental Business Journal Achievement Award: Bronze Medal.

2007:

- The 2006 North American Frost & Sullivan Award for Technology Innovation.
- The 2006 Environmental Business Journal Remediation Technology Merit Award.

2006:

- The 2006 Globe Award for Environmental Innovation & Application.

For more information, please visit our website www.iveyinternational.com or call our corporate office at 1-604-538-1168, or toll free at 1-800-246-2744.

Ref: Ivey-solTech Info 120914-03