

Business Description

Site Investigation

- Provide services for detailed site investigations on the extent of contamination and hydrogeology with cutting-edge investigation tools such as MIP(Membrane Interface Probe) to reduce remediation time and costs.
- We hold the qualification as a designated investigation agency by the Ministry of the Environment.

Remediation of Soil Contamination

- A group of interdisciplinary scientists and engineers from the fields of biotechnology, chemistry, geotechnical and civil engineering collectively focus on delivering the best solutions to the client.
- In-situ Bioremediation, chemical oxidation, and heavy metal stabilization, or a combination of these technologies are proposed as needed, in consideration of the site conditions and target goals.
- Target contaminants: VOCs, SVOCs, Pesticides, Heavy metals, Cyanides, Petroleum hydrocarbons, etc.

Manufacturing and sales of remediation products

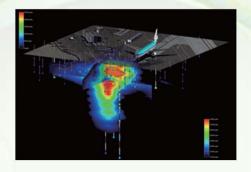
- We have been developing and manufacturing the remediation products at our factory.
- We have a lineup of various products such as EcoClean series to purify VOCs contamination, EcoClean-M for heavy metals contamination, and Green Clean series for petroleum hydrocarbons and cyanide contamination.
- We manufacture these remediation products at our factory in Japan by careful quality control standards and delivered to our customers.
- In addition, we have a wide range of remediation products that are best suited for site remediation such as chemical oxidants, heavy metal stabilizing products, etc. targeting various contaminants.

Water Treatment

- Provide water treatment technologies for contaminated groundwater, factory wastewater and wastewater of civil engineering works based on coagulation precipitation, membrane filtration, adsorption and ion-exchange, etc. to meet environmental discharge limits.
- These water treatment technologies are for heavy metals (hexavalent chromium, Selenium, Mercury, Cyanide, Arsenic, Fluoride, Boron, etc.), Dioxins, 1,4-dioxane and Petroleum hydrocarbons, etc.

Geotechnical Investigation ground improvement

- We asses the ground characteristics accurately by through boring surveys, surface surveys, soil tests, and in-situ tests.
- The ground improvement is made by injecting the solidified material to obtain the necessary ground strength for the foundation of the building and liquefaction measures are taken.











The Technological Strength of EcoCycle

Awards for excellence in research and technological development in soil and groundwater bioremediation



The Environmental Minister Award (2017)

Courtesy: National Institute of Environmental research, Ministry of Environment, Nikkan Kogyo Shimbun



Kinki Bioindustries Award (2017)

Patents Awarded in Japan and Overseas (Taiwan, USA and India)























Technical team comprising Engineers and Scientists

We are working on the development of state-of-the-art remediation solutions with our bioremediation products and technological applications effective for cleaning various soil and groundwater contaminants. We have a team of scientists and engineers from various disciplines analyzing the problems with interdisciplinary expertize providing appropriate site remedial design and implementation.

List of Qualifications:

- 4 Ph.Ds (Biotechnology, Chemical Engineering), 3 Professional Engineers (Construction Division),
- 1 Professional Engineer (Applied Science), 1 Professional Engineer (Water Supply),
- 1 Professional Engineer (Sanitary Engineering Division), 1 Professional Engineer (Water and Sewer Division),
- 16 Soil Contamination Investigation Technical Managers, 2 Soil Environment Supervisors,
- 21 First-Class Civil Engineering Works Execution Managers, 11 Second-Class Civil Engineering Works Execution Managers,
- 3 First-Class Piping Works Execution Managers, 14 Soil Environment Conservation Specialists, 13 Soil Environmental Risk Managers,
- 3 Type 1 Water Quality Pollution Control Managers, 1 Type 1 Air Pollution Control Manager, 6 Geological Survey Technicians,
- 1 Ground Quality Assessment Engineer, 2 Environmental Measurer

Overseas Support

Support on remediation of soil contamination

- Laws on soil contamination are getting stricter overseas as well.
- In some cases, site remediation is necessary before the closure or relocation of overseas factories.
- There is a risk of soil contamination when conducting land trading, M & A, etc. overseas.

Provide Solutions

- We have multiple overseas offices and networks.
- We can also support overseas governments by utilizing our locally-trained consultants, who are familiar with local environmental laws.
- We can provide on-site remedial solutions by our extensive experience and know-how from a variety
 of sites remediated in Japan and overseas.

Business Network



Brownfield Solution

Relocation, closure or partial sales of defunct factories is a bottleneck due to soil contamination



Bottleneck in developing former manufacturing facilities;

- Wanting to sell the old factory/land, but not finding the buyer because of soil contamination.
- The remediation cost is too high compared to land cost thus making it difficult to decide.
- Not sure if the land can be sold at market price after the remediation.

Brown-Field Solution

Provide total solutions for site redevelopment from contaminated and abandoned facilities

EcoCycle

Demolition Contractor

Major Real estate Developer

Buy contaminated land and factory

Dismantle the factory

Soil contamination investigation and remediation

Real estate development

Guaranteeing Remediation

Major Trading

Company

EcoCycle guarantees remediation of contaminated sites with cost cap insurance

Flow of site remediation guarantee

1

Grasp the site contamination conditions

Site investigation to discover contamination and hydrogeology

2

Studies on remediation selection and performance

Selection of remedial alternatives and developing conceptual model

3

Determine remediation goal, scope of guarantee <u>Insure for site remediation</u>

On consultation we decide the remedial target. In addition, we clarify the acceptance conditions and the scope of remedial guarantee



Full-scale remediation and contaminants monitoring

Implement full-scale site remediation followed by groundwater, soil monitoring.

5

Achieve the target goals within your budget

List of EcoCycle Remediation Products



Tetrachloroethylene, trichloroethylene, trichloroethane, carbon tetra chloride, dichloroethylene, dichloromethane, vinyl chloride, chlorobenzene, etc.

Product Name	Application overview		
	EcoClean and EcoClean-E Anaerobic biostimulants for VOCs and effective for silt-clay soils, coastal areas, etc.		
EcoClean EcoClean-E	EcoClean-ZVI It is a mixture of biostimulant and Zero valent Iron Effective for high contaminant concentrations and as a permeable reactive barrier (PRB)		
EcoClean-X	Anaerobic biostimulant for degradation of chlorobenzenes, chlorophenols, etc.		
BioFlush-X	In-situ flushing agent for VOCs, petroleum hydrocarbons		
COA-X	In-situ chemical oxidizing agent (sodium persulfate) for VOCs, 1,4-dioxane, mixture of complex organic contamination (VOCs and petroleum hydrocarbons), etc.		

Heavy Metal Contamination

Hexavalent chromium, Mercury, Lead, Cadmium, Arsenic, Selenium, Fluoride, Cyanide, etc.

Product Name	Application overview		
EcoClean-M	Biostimulant for heavy metal stabilization of Hexavalent chromium , Cadmium , Mercury , Lead , Arsenic , Mercury , etc.		
NanoLite Earth	Heavy metal stabilizing agent for Cadmium, Lead, Chromium, Arsenic, Mercury, Selenium, Copper, Zinc, Nickel, Fluoride, Cyanide, etc.		

List of EcoCycle Remediation Products

Petroleum Oils, Cyanides Contamination

Benzene, toluene, ethylbenzene, xylene, gasoline, kerosene, diesel oil, heavy oil, aromatics, cyanide compounds, PAHs, chlorobenzenes, chlorophenols, vinyl chloride, 1,4-dioxane, etc.

Product Name	Application overview		
Green Clean-PH	Biostimulant for aerobic degradation of benzene, gasoline, kerosene, diesel, light oils, etc.		
Green Clean-CN	Biostimulant for Aerobic remediation of cyanide compounds		
Green Clean-X	Biostimulant for aerobic degradation of dichlorobenzene, chlorobenzene, etc.		
OleoBact	Effective microorganisms to degrade high concentration of petroleum hydrocarbons (benzene, kerosene, diesel, light oils), etc.		
HAR-OX	An oxygen releasing agent that release dissolved oxygen essential for aerobic remediation of contaminants.		
COA-X	<i>In-situ</i> chemical oxidizing agent (sodium persulfate) for petroleum oil degradation (benzene, kerosene, diesel, light oils), etc.		

Nitrate Contamination

Nitrate and nitrite compounds, etc.

Product Name	Application overview		
EcoClean-N	Anaerobic biostimulant for nitrate and nitrate remediation		

Extensive Site Remediation Experiences

Our clients range from large multinationals to local and central governments

Overseas Projects

Electric and Electronic

Automobile

Precision Tools

Power Plants

Heavy Industry

Chemicals, Pesticides

Petrochemicals

Metal Plating, Surface cleaning



Textile Cleaning

Representative Clients

MM Building Materials Co. Ltd. Konoike Group Co., Ltd.

Nippon Steel Sumikin Engineering Co., Ltd

Takenaka Corporation

Takenaka Civil Engineering Co., Ltd.

Hitachi Plant Service Co. Ltd.

Mitsui Construction Road Co., Ltd.

Mitsui Sumitomo Corporation Mitsui Bussan Chemical Co., Lt 900 Sites



Taiwan



USA

Experience in variety of site conditions

Government Site Remediation Projects

- Adopted as low-cost, environmentally friendly remedial technology for site clean up (Test Results published, November 2005).
- Site remediation was completed at flower garden area of Fukuoka Kitakyushu Expressway Corporation(June 2006).
- First of its kind, "Subsidy from soil contamination remediation fund" from the Ministry of Environment, (December 2007). This site was confirmed free of contamination (1st November 2011).
- Adopted for contaminated site remediation at illegal dump site at Iwate-Aomori prefectural border (March 2009).

Site assessment & investigation to grasp the extent of contamination

Site Assessment

- History of Hazardous Chemicals Use, Storage, Leakage, etc.
- History of Land Usage by Surrounding Facilities

What we know

- Possibility of Site contamination
- Area mapping for Site Investigation

Site Investigation

- Surface Soil Investigation, Soil Gas Analysis
- Investigation of groundwater contamination by the existing monitoring wells

What we know

- Extent of contamination (planar)
- Type of contaminants, concentrations, etc.

Obtain additional site investigation data for remedial design and development

Important

Detailed Investigation

Understand Contamination & Geological Features

【Contaminant Distribution】

- Contamination source (Hot Spot) & Pathway
- Contamination Distribution Against Depth and at Vadose Zone, around groundwater level.
- · Other site conditions

[Hydrogeology]

 Presence of clay lenses & distribution of organic matter

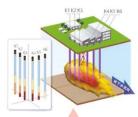
· Soil permeability, hydraulic conductivity, etc.

[Validation of influencing parameters]

·ORP, PH, co-contaminant, buried objects, etc.

What we know

- Appropriate remedial options
- Estimation of remediation cost
- Other data required for full-scale remedial design and execution



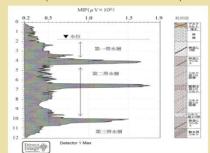
EcoCycle Registered under the Designated Authority. (Ministry of Environment 2014-3-17)

We believe that detailed site investigation is key to successful site remediation

Why is a detailed site investigation required?

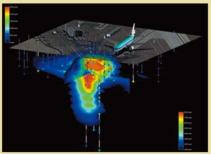
Detailed site investigation by advanced methods such as MIP provide in-depth knowledge of contamination distribution and site hydrogeology. This helps us to develop the best remedial design while minimizing remediation time-frame and total costs.

MIP (Membrane Interface Probe)



MIP is a Real Time Site Investigation Tool

3D Distribution of Contamination



Source: ISS Corporatio

Feasibility of Remedial options are evaluated in the Laboratory

In-situ pilot test for obtaining site data for full-scale remedial design

Full-Scale Site Remediation!

Laboratory Test

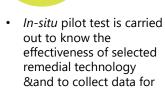
Option

 Soil & groundwater obtained from the site is tested in the laboratory with various remediation options (2~4months)

What we know

- Remediation options
- For
 Bioremediation:
 Microbial growth & degradation rates
- For chemical oxidation: Product dosage, degradation rates
- Other factors

Field Test



full-scale remedial

design

What we .

- Effectiveness of selected remedial technology
- Site cleanup cost and time-frame
- Trouble shooting in the field
 - → For full-scale remedial design & cost estimation

Remedial Design



Based on the site investigation and field pilot test data, full-scale remediation design and implementation plan are developed, including remedial goals, cost, schedule, monitoring, etc.

Remedial Implementation

Remediation of Chlorinated compounds



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Remediation of Petroleum Hydrocarbons, Cyanides



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Remediation of Heavy Metals



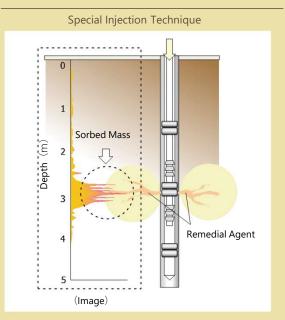
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Explanation to the Government authorities

We will carefully support until successful Site remediation



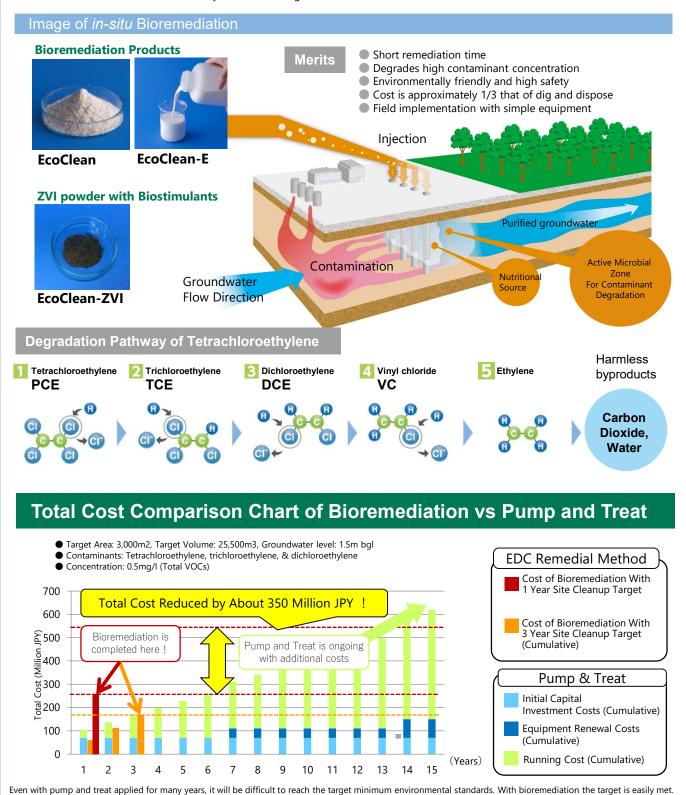
Special injection techniques are applied based on the site hydrogeology and contamination circumstances to distribute remedial agents evenly throughout the target area for effective remediation



Remediation of Chlorinated Compounds

In-situ Bioremediation (Biostimulation)

Bioremediation is an environmentally friendly remedial technology where indigenous microbes are stimulated by injecting proprietary biostimulants such as EoClean. These microbes degrade toxic compounds into harmless water and carbon dioxide. The EcoClean series of biostimulants applied here for bioremediation are made of food materials and consist of amino acids, vitamins, etc. and are environmentally safe and biodegradable.



Representative Target Contaminants

Haloginated organic compounds such as tetrachloroethylene, trichloroethylene, trichloroethane, carbon tetrachloride, dichloroethylene, dichloroethane, dichloromethane, chloroethylene(vinyl chloride), chlorobenzene, etc.

In-situ Bioflushing

Bioflushing is an appropriate and quick remedial measure targeting high concentration/complex contaminated source areas and adsorbed to soil particles. Injection of bioflushing agents dissolve the soil adsorbed mass and contaminants are then extracted and treated off-site. The residual subsurface concentration in subsurface is treated by *in-situ* bioremediation reducing the cost and the remediation time.

Suitable site

- Poorly water soluble contaminant
- High contaminant concentration

Bioflush-X

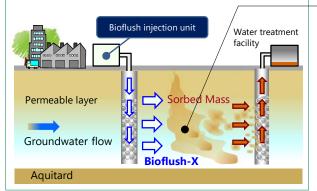




Image of soil cross-section

In-situ Chemical Oxidation

This is a method to degrade contaminants by oxidizing agent (Persulfate, Fenton, etc.). Chemical Oxidation is a preferred method to treat high concentration contaminants and complex contaminants with short-term remediation goals.

Suitable site

- Short-term remediation goal
- Good hydraulic conductivity
- Complex contamination such as VOCs, Benzene, TPH
- Contaminants in vadose zone
- · Less effective in silty soils & high organic matter

Chemical Oxidant



COA-X



Other Remedial Techniques

Lime mixing treatment

Here, contaminated soil is mixed with lime to raise soil temperature and evaporated VOCs are collected and treated by activated carbon. Additional soil heating enhances the evaporation of VOCs, SVOCs.

Suitable site

- Vadose zone contamination
- To meet short remedition time

Soil vapor extraction

Volatile organics in the vadose zone are extracted and treated

Suitable site

- Factories and buildings under operation
- For vadose zone soils

Containment

A wall is installed in a grout of steel sheet piles in the target area by shutting down groundwater flow for avoiding health risk.

Suitable site

- To avoid urgent spread of contamination
- Concentration is below the secondary elution standard
- When contaminated site is large and not economical to clean
- Not able to do remedial works due to factory circumstances
- To prevent external contamination

Remediation of Petroleum Hydrocarbons, Cyanides, etc.

In-situ Bioremediation (Biostimulation)

Green Clean is a nutrient source for aerobic microorganisms



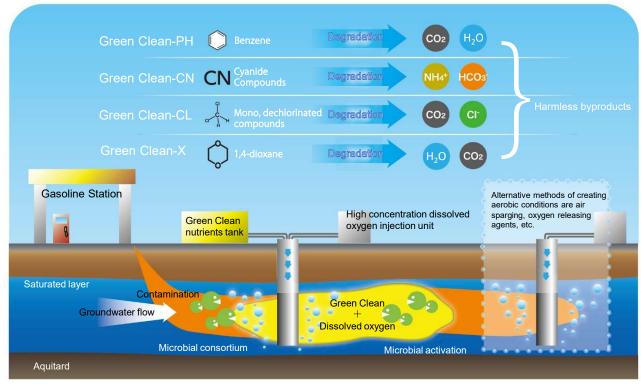
Green Clean is a nutritional supplement for indigenous microorganisms capable of degrading contaminants such as petroleum oils, cyanides, etc. Green Clean is injected along with a dissolved oxygen source required for aerobic microorganisms.

Suitable site

- BTEX, light oils, etc.
- For low concentration of contaminants and wider plumes.
- Overburden saturated zone
- Low cost in-situ remedial alternative
- · Good at active facilities/factories or under the buildings

Oxygen releasing Agent, HAR-OX





Bioremediation (Bioaugmentation)

OleoBact



Oleobact is an effective microbial consortium that is injected into the subsurface or mix with excavated soil to expedite the contaminated site remediation where indigenous microorganisms are not capable of degrading high concentrations or to reach faster remediation goals.

- Product is registered in US EPA National Emergency Responsive Plan Product Inventory.
- Registered in the Ministry of Land, Infrastructure and Transport, (NETI), Japan

Case studies

Number of sites: applied at over 100 remediation sites in Japan Contaminants: BTEX, gasoline, kerosene, diesel, heavy oil, lubricating oil, etc.

Target area: Implementation in the range of 10m2 ~ 2,500m2

Target Contaminants

Benzene, toluene, ethylbenzene, xylene, gasoline, kerosene, light oil, heavy oil, poly aromatic hydrocarbons (PAHs), cyanide compounds, dichloroethylene, chloroethylene(vinyl chloride), 1,4-dioxane, etc.

Chemical Oxidation

This is a method to degrade contaminants with oxidizing agents (Persulfate, Fenton, etc.). Chemical oxidation is a preferred method to treat high concentration and complex contaminants with short-term remediation goals.

Suitable site

- Petroleum hydrocarbons
- Low to moderate contamination
- Applicable for vadose zone and saturated layers
- Mixture of complex contamination such as petroleum hydrocarbons and VOCs
- Shorter cleanup target
- · Less organic matter in soils

Chemical Oxidant









Ecothermo flush

Soil contaminated with petroleum hydrocarbons is mixed with Green Clean-X by creating biopile and aerobic condition are met by sucking air into the pile. This process stimulates native aerobic microflora and the temperature of the pile rises steadily. Once the temperature crosses 50 degrees centigrade, thermophiles kick into action to degrade target contaminants.

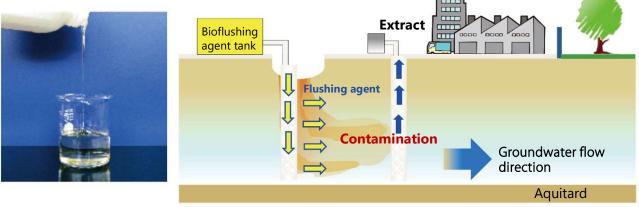


Bioflushing

Cyanide contaminants (ferri and ferro cyanides, etc.) are produced during coal gasification. Most of these compounds are not soluble in water and are persistent in soils. Bioflushing agents are injected into those soils and in this process soil adsorbed metal-cyanide mass is dissolved in groundwater followed by pump-and-treating the dissolved phase. Subsequently, bioremediation is applied to remediate remaining residual contamination in subsurface.

Suitable site

- Cyanides that are difficult to degrade
- Those which are difficult to dissolve in water
- Other compounds, dioxins, etc.



Remediation of Heavy Metal Contamination

Metal Stabilization Technology

NanoLite Earth is a material that stabilizes ionized and soluble metals in soil and groundwater, making them insoluble in soil-water systems and preventing the elution of heavy metals into the groundwater. This product is applicable for most metal contaminants. This material is made from natural minerals, and/or biostimulants. Unlike cement based stabilizing agents, Nanolite Earth doesn't impact natural soil properties as the pH of treated soil is near neutral.





NanoLite Earth

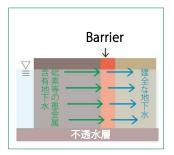
Nanolite Earth design dosage depends on types of metals and its concentrations



Surface soil treatment

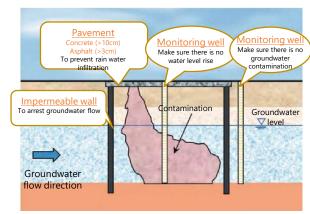


Barrier application by trench

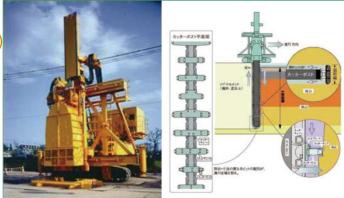


Containment

Containment enclosures of sheet iron or concrete walls are made in order to shut-off contaminated groundwater flow to the surrounding areas. Here, a high quality concrete or iron wall is being made around the target area, blocking contaminated groundwater flow.



Source : Soil Pollution Prevention Guidelines for SMEs (Environment Bureau, Tokyo Metropolitan Govt.)



Source: TRD Construction Association Website

Merits of TRD Construction

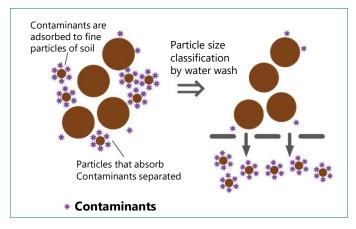
- Effective method of containing contaminated groundwater, useful or waste disposal facilities, etc.
- lacktriangle A low cost TRD wall is made from drilled soil from the site mixed with cement-like materials.
- Construction of homogeneous TRD with hard surface and cobblestone layer with excellent continuity.
- Applicable Soil: N value <100, gravel size <100mm, wall thickness: 450~850mm, and applicable depth up to 60m</p>

Target Contaminants

Hexavalent chromium, selenium, uranium, mercury, led, cadmium, arsenic, fluoride, cyanide, etc.

Soil Washing

Most of the heavy metals are adsorbed to fine particles due to large surface area. By separating the fine particles from the soil contamination with water wash largely minimizes waste disposal volume of soil.





Heavy Metal Soil Washing Equipment

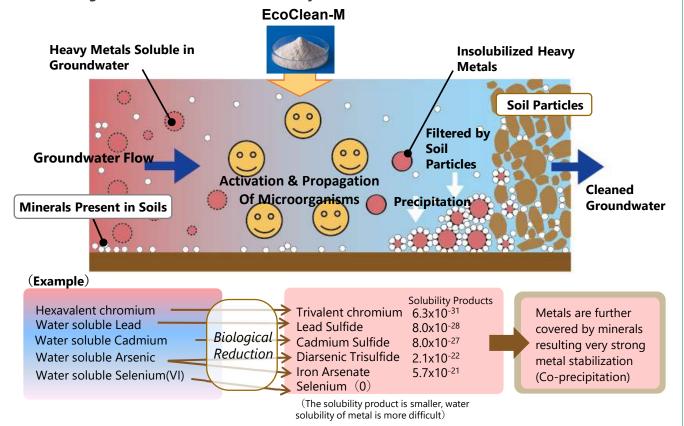
Soil cleaning with chemicals/solvents

Depend on the type of heavy metal contamination and concentration, the removal rate may vary by water wash and some times may not reach to target levels. Thus, the contaminant removal rate can be increased by washing soil with chemicals/solvents.

Bioremediation

EcoClean-M is a proprietary biostimulant injected into a heavy metal contaminated subsurface to stimulate indigenous microorganisms, including sulfate reducing microorganisms. The reduced sulfate forms sulfide which reacts with soluble heavy metals to form insoluble sulfide minerals. On the other hand, hexavalent chromium is biologically reduced to trivalent chromium.

An Image of Groundwater remediation by EcoClean-M



Water Treatment Technology

EcoCycle provides wastewater and groundwater treatment plants for various hazardous substances and supports the client based on their various water treatment needs.

Some of the Water Treatment Examples

Factory Wastewater Treatment

Provide water treatment plant installation, operation and maintenance services



Groundwater Treatment

Equipment for groundwater pumping and treatment of VOCs, Heavy Metals, Pesticides, and oils



Demolition of the Incinerators

Equipment for concentration of DXNs wastewater from the demolition of incinerators



Others

Provide demonstration units for field testing

Sludge Dredging

Equipment for sludge dredging and water treatment.



Please contact us for your water treatment needs

Process Flow

We provide water treatment plants for groundwater contaminants, cyanides, VOCs, petroleum hydrocarbons, heavy metals, dioxins, etc. and also for turbid water generated by factories and civil engineering works.

Consultation on client issues



Laboratory testing of water samples

Collect contaminated water samples and select best treatment option based on the laboratory testing.

Plant design

Water treatment plan is designed based on the client requirements selected from coagulative precipitation, sedimentation, filtration, adsorption or ion-exchange, etc. depend on the wastewater or sludge characteristics.

Plan supply and operation

We also provide all types of water treatment plants in cooperation with our partner companies. We will submit the water treatment plant operation and maintenance manuals upon plant installation and demonstration at the client site.



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