EBD TECHNOLOGY FOR SOIL REMEDIATION

SUSTAINABLE & AFFORDABLE SOLUTIONS TO REMEDIATE LARGE TRACTS OF LAND POLLUTED WITH CRUDE OIL, HEAVY METALS & OTHER CONTAMINANTS

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Remediation: Air, Water and Soil

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1) ENVIRONMENTAL BALANCE DEVICE (EBD) TECHNOLOGY BENEFITS IN SOIL REMEDIATION APPLICATIONS

A) EBD technology fully remediates organic and inorganic contaminants (including crude oil) in soil, and costs significantly less than any other conventional soil remediation technology.
B) The EBD process is sustainable, non-intrusive and does **not** use: 1) Excavation, 2) Injection, 3) Chemical Decomposition, 4) Bioremediation, 5) Thermal Desorption, 6) Microwaves, 7) Aeration, 8) Active Carbon, 9) Soil Gas Suction, 10) Soil Dilution, 11) Lime or, 12) Electric Power.
C) EBD systems fully remediate soil and ground water down to over 2,000 meters in depth.
D) There is no need to tear down or remove any structures or facilities located in the EBD soil remediation area. EBD technology will remediate all soil such structures and facilities are built on.
E) Foul odors emanating from polluted soil sites, will effectively be eliminated shortly after installing EBD systems.

2) EBD TECHNICAL SUMMARY FOR SOIL REMEDIATION APPLICATIONS (Short Version)

All matter on Earth contains positive and negative energy particles. Environments containing man-made chemicals and pollution such as in excavated oil fields, contain excessive levels of negative energy particles (NEP-) and lack sufficient levels of PEP+. Excessive NEP- volumes are detrimental to living organisms such as microbes. EBD units attract positive energy particles (PEP+) which are naturally present in the ecosystem. By creating an energy particle balance between NEP- and PEP+ levels, all atomic frequencies of all matter situated above, below and around the EBD perimeter surrounding the EBD treated soil remediation perimeter, are naturally optimized causing all natural and indigenous microorganisms present within the EBD balanced perimeter to become much more active and much more prolific. By naturally optimizing: A) atomic excited states and frequencies in matter, B) microbial life in nature and C) physical properties of various natural elements in soil polluted with refined or crude oil, EBD systems provide the benefits enumerated above in Section 1, in an environmentally sustainable, green and affordable way.

3) SOIL CONTAMINATION AND RISKS

Soil contamination or soil pollution is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals, or improper waste disposal. The most common chemicals involved are petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene and benzo(a)pyrene), solvents, pesticides, lead, and other heavy metals.

Contamination is correlated with the degree of industrialization and intensity of chemical usage. (Wikipedia Nov. 2015)

The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil, vapors from the contaminants and from secondary contamination of water supplies within and underlying the soil. Mapping of contaminated soil sites and the resulting cleanup are time consuming and expensive tasks, requiring extensive amounts of geology, hydrology, chemistry, computer modeling skills, and GIS in Environmental Contamination, as well as an appreciation of the history of the industrial chemistry the waste from factories. (Wikipedia Nov. 2015)

4) TYPES OF CONTAMINANTS AND CONVENTIONAL REMEDIATION METHODS

Many manufacturing plants and facilities use hazardous substances in their day to day operations. It is not uncommon for such hazardous substances to leak or spill from tanks, piping, improper handling, accidents and the like.

A. Some Examples of Contaminated Facilities

a. Class 1 Hazardous Substances: Metalworking operations, vehicle manufacturing plants, plating operations, dry cleaning facilities (using tetrachloroethylene) chemical agent manufacturing plants.
b. Class 2 Hazardous Substances: Semiconductor plants, vehicle manufacturing plants, plating operations, and chemical agent manufacturing plants, some land fill sites.
c. Class 3 Hazardous Substances: Some agricultural sites, some landfill sites.
d. PCBs: Plants that employed transformers containing PCBs.
e. Oil: Plants that are equipped with heavy oil tanks and boilers.
f. Dioxins: Plants that produce heavy chemical products (equipped with incinerators)

B) Excavation and Removal Methods

There are several excavation and removal methods such as chemical decomposition, adding lime, oxidation decomposition, Bio-remediation, soil gas suction, ground water aeration etc.

C) Gasoline Stations (Fuel Supply Facilities)

Gasoline station facilities store and dispense petroleum products such as gasoline, diesel, kerosene and other refined oils. Soil and ground water contamination can result when the storage tanks and piping leak resulting in the hydrocarbon based products being introduced into the ground. Common pollutants include, but are not limited to, Trimethylbenzene,

Isopropyltoluene, Benzene, Ethylbenzene, Isopropylbenezene, m.p.Xylene, Methyl tert-butylether, Naphthalene, n-Butylbenzene, n-Propylbenezene, o-Xylene, sec-Butylbenzene, Toluene, MTBE, Tetrachloroethene (PCE), Trichloroethene (TCE) etc. If the gasoline station facility in question dispensed leaded gasoline, lead contamination may also be present in the soil and groundwater.

5) CONVENTIONAL SOIL REMEDIATION METHODS AND LIMITATIONS

A) **Soil washing method**

This method involves washing contaminated soil containing metals and/or oils. It has practical applications in the extraction of metals from mineral ores and the soil is separated into washed soils and concentrated substances. The concentrated substances are recycled for refining raw materials.

B) **Iron powder method**

Soil contamination caused by organic chlorine compounds is treated by mixing special iron powders to decomposed and eliminate contaminated substances. This method can be conducted on-site and treatment costs can be reduced.

C) **Thermal treatment method**

There are various thermal treatment methods. If the contaminants are volatile organic substances, volatile removal through a medium temperature can be achieved. If pyrolysis is required, high temperature heat treatment is required.

D) **Bio-remediation** (Microorganisms)

Organic compounds such as oil can be treated using microorganisms in the soil. This method can be conducted on-site, therefore, treatment costs and the burden on the environment can be reduced.

E) **Pumping Up Method**

Contaminated water is pumped and treated. This method can be effective in preventing contamination ground water migration.

F) **Soil vapor extraction**

This method involves the collection of volatile organic chlorine compounds which are suctioned from the soil.

G) **Solidification / Insolubilizing (In Situ Vitrification / Chemical Oxidation)**

This method suspends the elution of contaminants by converting them into immobilized states to reduce the risk of soil contaminant diffusion.

H) **Encapsulation**

The encapsulation method is implemented in slightly or highly contaminated soils in those cases where the other conventional soil remediation methods are inadequate. Measures employed depend on the target contaminates in question. There are wide ranging measures which need to be considered, such as whether merely preventing diffusion to non-contaminated areas and/or complete isolation from non-contaminated areas.

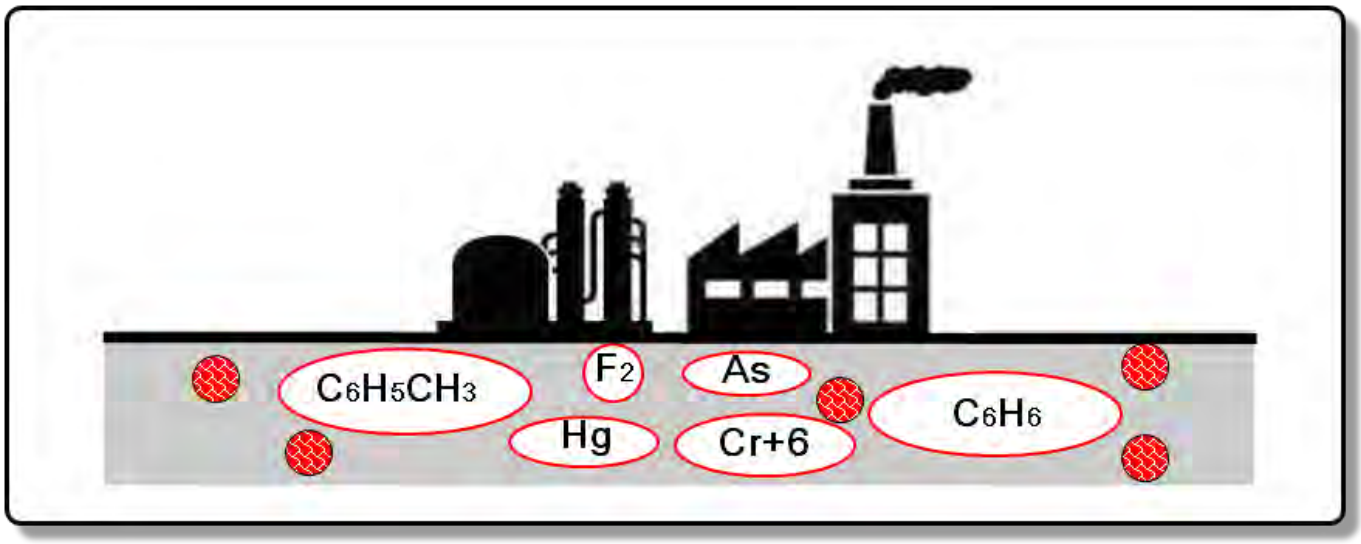
I) **Excavation / Removal of Contaminated Soil**

This type of operation differs from normal engineering works, thus environmental measures for the surrounding areas should be implemented as contaminated soil is excavated and transported. Dust particles scattering from the excavation area can contain hazardous substances so the level of risk from contamination should be estimated and the surrounding environment should be carefully managed.

Many companies which contaminate soil and/or ground water, do not have the economic resources necessary to effectively remediate, given the high costs associated with conventional soil remediation techniques.

In addition, in a number of advanced countries, the environmental authorities establish soil remediation standard target values at very low levels and in many cases, conventional remediation methods, are hard pressed to be able meet those stringent standards

6) CLASS 1, 2, & 3 SPECIFIED TOXIC SUBSTANCES



A) Class 1 Specified Toxic Substances

Item	Elution Standards (ppb)	Containing Value (mg/kg)	Groundwater Standards (ppb)
Carbon Tetrachloride	2	-	2
1,2- Dichloroethane	4	-	4
1,1-Dichloroethylene	100	-	100
Cis 1,2-Dichloroethylene	40	-	40
1,3,-Dichloropropene	2	-	2
Dichloromethane	20	-	20
Tetrachloroethylene (Park Ren)	10	-	10
1,1,1-Trichloroethane	1000	-	1000
1,2-1 Trichloroethane 1	6	-	6
Trichloroethylene (Trichlene)	30	-	30
1,2,4-Trimethylbenzene	5		
1,3,5-Trimethylbenzene	5		
4-Isopropyltoluene	5		
Benzene	1		
Ethylbenzene	5		
Isopropylbenzene	5		
m,p-Xylene	5		
Methyl tert-butyl ether	10		
Naphthalene	5		
n-Butylbenzene	5		
n-Propylbenzene	5		
o-Xylene	5		
sec-Butylbenzene	5		
Toluene	5		
Total VOCs			
Acenaphthene			
Anthracene			
Fluoranthene			
Fluorene			
Phenanthrene			
Pyrene			

B) Class 2 Specified Toxic Substances

Item	Elution Standards (ppb)	Containing Value (mg/kg)	Groundwater Standards (ppb)
Cadmium and Cadmium Compound	10	150	10
Chromium VI and Chromium VI Compound	50	250	50
Cyanide Compounds	non-detected	50	non-detected
Mercury and Mercury Compound	0.5	15	0.5
Alkyl Mercury and Alkyl Mercury Compounds	non-detected	-	non-detected
Selenium and Selenium Compound	10	150	10
Lead and Lead compounds	10	150	10
Arsenic and Arsenic Compound	10	150	10
Fluorine and Fluorine compound	800	4,000	800
Boron and Boron Compound	1000	4,000	1000

C) Class 3 Specified Toxic Substances

Item	Elution Standards (ppb)	Containing Value (mg/kg)	Groundwater Standards (ppb)
Simazine	3	-	3
Thiram	6	-	6
Thiobencarb	20	-	20
Organic Phosphorus	non-detected	-	non-detected
PCB	non-detected	-	non-detected
(D) Other			
Dioxin	<100pg-TQE/g 250pg-TQE/g Further Investigation is required		
Oil	Only Guidelines ／No standard value		

7) ENVIRONMENTAL BALANCE DEVICE (EBD) TECHNICAL EXPLANATION (Long Version)

The EBD remediation method differs from all other conventional physical and chemical soil remediation methods. Sites contaminated by organic and inorganic pollutants contain high volumes of free radicals, active oxygen as well as negative elementary particles NEP (-), all of which cause ecosystem imbalance. This lack of balance negatively affects indigenous microbial life limiting their ability to feed, excrete, secrete and propagate as they would normally do in a

balanced environment. The EBD remediation process begins by first recovering the environmental balance at the site to be remediated.

Microorganisms, which originally exist in nature, can aerobically propagate by gaining energy through petroleum-based hydrocarbons which act as electron donors and through oxygen which acts as an electron acceptor.

When crude oil, gasoline, and other petroleum based fluids leak from tanks, oil well facilities, refineries etc. and permeate into soil, these fluids do not fully decompose and remain underground for extended periods of time. The reason for this is not due to the absence of microorganisms which can decompose the petroleum based fluids, but to the shortage of the oxygen electron accepters which causes oil decomposition to cease. If, however, sufficient amounts of oxygen can be introduced into the soil, an already present yet dormant specialized group of microorganisms which digest oil, will awake and propagate.

Ensuring an effective oxygen supply into the soil is a key factor. There are some already existing methods which have been implemented to increase oxygen supply into the ground. These include 1) pumping air into groundwater which has been pumped up to the surface thus producing a highly concentrated dissolved oxygen state and thereafter re-injecting it back underground, 2) installing pipes in wells for pumped air injection, and 3) hydrogen peroxide injection (which produces oxygen) and drawing the groundwater from other wells located in the vicinity in order to accelerate groundwater flow movement and thus spread oxygen through that particular water table.
These conventional methods however, require electrical power to pump/inject air and water. One of the advantages of bioremediation is that it can decompose contaminants without the need for electric power. In the mid 1990's, Bioremediation was heavily promoted due to the development of an oxygen releasing agent containing magnesium peroxide. When magnesium peroxide contacts with water, it rapidly reacts and is converted into magnesium hydroxide thus releasing the oxygen into the water. The reaction of the oxygen release agent is controlled by special surface treatment which involves a powder-formed particle which continues to function between 6 to 12 months. This treatment process involves the use of boring equipment. The ground is bored down to a fixed depth at the contaminated site and then the oxygen releasing agent known as "aquatic slurry" is injected into the ground. Oxygen is continually supplied into the ground for 6 to12 months and petroleum-based hydrocarbons decompose through the activation of a specialized group of microorganisms.

There are various kinds of microorganisms such as bacteria, actinomycetes and filamentous fungus (mold) which exist in soils and have important functions for the circulation of materials in surface soil. Most organic substances such as plant residues, are digested by those microorganisms in the soil and inorganic substances which remain, will be reused as nutrition for plants in the cycle of the natural chain. When balanced microorganism functions are interrupted through the introduction of various pollutants, nature's cycle is also broken and the

ecosystem is negatively affected.

Soil contamination causes a negative impact to not only humans but also the microorganisms in the soil. It is well known that heavy metal contamination leads to a decrease in bacteria and actinomycetes and an increase in filamentous fungus in the soil. In addition, the acidification of soil has become a serious issue resulting from acidic rain which may also lead to a decrease in bacteria and actinomycetes and an increase in filamentous fungus. The reduced amounts of actinomycetes and decomposed organic substances can be tested and confirmed by adding various concentrations of metals into soils and then calculating the amount of microorganisms and organic substances present. Bioremediation is not an entirely flexible technology and does not always treat contaminated substances effectively nor thoroughly.

Microorganisms use various elements for their metabolic functions and to also resist various toxic elements. Microorganism resistance to heavy metals are classified into the following two categories 1) Resistance to absorption into their cells, and 2) transfer/discharge of the heavy metals outside of their bodies.
Various kinds of transporters (enzymes) which have been found in microorganisms include membrane proteins existing in the biological membranes which have the natural function to discharge physiologically active substances such as sugar and amino acids, hormones and metals in, as well as out of the microorganism cells. It is known that the mechanism of heavy metal resistance, is indicated through the transporters which can reduce the concentration of heavy metals in the cells.

A) **Isolation within the cell through metalloproteins:** Microorganisms bond with heavy metals, metalloproteins and/or peptides (bonds with amino acid molecules) in their cells. Present day scientific understanding takes the position that microorganisms absorb heavy metals in their cells and release them in their original form when they perish. With the implementation of EBD technology, we obtain very different and demonstrable results.

B) **Isolation out of the cells:** Heavy metals bond with polysaccharides or oxalic acid which are ejected or precipitated outside of the cells.

C) **Conversion to non-toxicity form:** Highly toxic Hg^2 (mercury) is resolved to Hg0 and the produced Hg0 evaporates and diffuses from the cell into the atmosphere. Such a mechanism occurs not only for mercury but also for arsenic and selenium which evaporate through microorganisms. This represents an important pathway for microorganisms to discharge transmuted substances from the inside of their cells out into the atmosphere.

An important point regarding the above mechanisms, is that contaminated substances such as heavy metals, organic solvents, agricultural chemicals, and oils cannot be eliminated through the activation of microorganisms using the conventional bioremediation method. With EBD technology, however, microbial activation differs completely from conventional microorganism activity and such substances are in fact eliminated through microorganisms functioning under the influence of EBD systems. EBD technology restores the original environmental conditions which existed prior to the introduction of the heavy metals and other pollutants in question.

Biosynthesis is when organisms (microorganisms) produce biomolecules. The process of primary metabolic pathways in which substrate compounds such as amino acids, sugar, fatty acids, and nucleic acids are synthesized, is common with various organisms. The process of secondary metabolic pathways is when specific compounds such as hormone, pheromone, and toxins are synthesized.

Generally, when a single kind of compound is synthesized, various enzymes are connected such as oxidation-reduction enzymes, transferase, synthesize enzymes, and/or hydrolytic enzymes and then multiple steps are taken.

By installing the EBD units around the perimeter of the contaminated area in question, the concentration of Positive Energy Particles (PEP+) will increase over time. Under a balanced environment, corrosive and destructive Reactive Oxygen Species (ROS) will combine with free electrons in the contaminated area being remediated. As the amount of ROS levels decrease, indigenous microorganisms will commence to propagate exponentially. Under such a balanced environment, the microorganism cells and atoms as well as the atomic frequencies of all other matter contained within the EBD treated perimeter, such as heavy metals, organic solvents, agricultural chemicals, crude oil, its derivatives and aromatics which have caused environmental contamination, are changed from a ground state to a higher energy excited state.

As a result, acidic soil will become neutral and in a neutralized soil environment, bacteria and actinomycosis begin to once again proliferate.

Microorganisms which exist in the natural environment, have different frequencies than those existing in contaminated substances. By enhancing the frequencies between the microorganisms and the contaminated substances, this leads to a smooth interaction between the two under a natural environment brought about by the implementation of EBD technology. An increase in the number of vibrations leads to microorganisms being able to feed on contaminated substances. When the microorganisms feed on contaminated substances, they secrete various enzymes from their bodies through biosynthesis. The amount and types of such

abundant secretions, differ completely from conventional microorganism secretions. The types of enzymes are oxidation-reduction enzymes, transferase, synthetase, and hydrolase, in addition to biological transmutation enzymes.

8) ENVIRONMENTAL TRANSMUTATION PROCESSES

Biological Transmutation is defined as a specific element transmutation occurring in living organisms. Substances are basically composed by a chemical reaction by gaining energy through the oxidation reaction and reducing reaction resulting from inter-atomic electrical exchanges. Four fundamental interactions, also called interactive forces, are conventionally recognized and this reaction uses Electromagnetic Interaction (force) in those fundamental interactions.

The process of element transmutation is caused by the function of Strong Nuclear Interaction in an atomic nucleus instead of the inter-atomic electrical exchanges. Strong Nuclear Interaction is tens of thousands of times stronger than Electromagnetic Interaction (inter-atomic electrical exchanges).

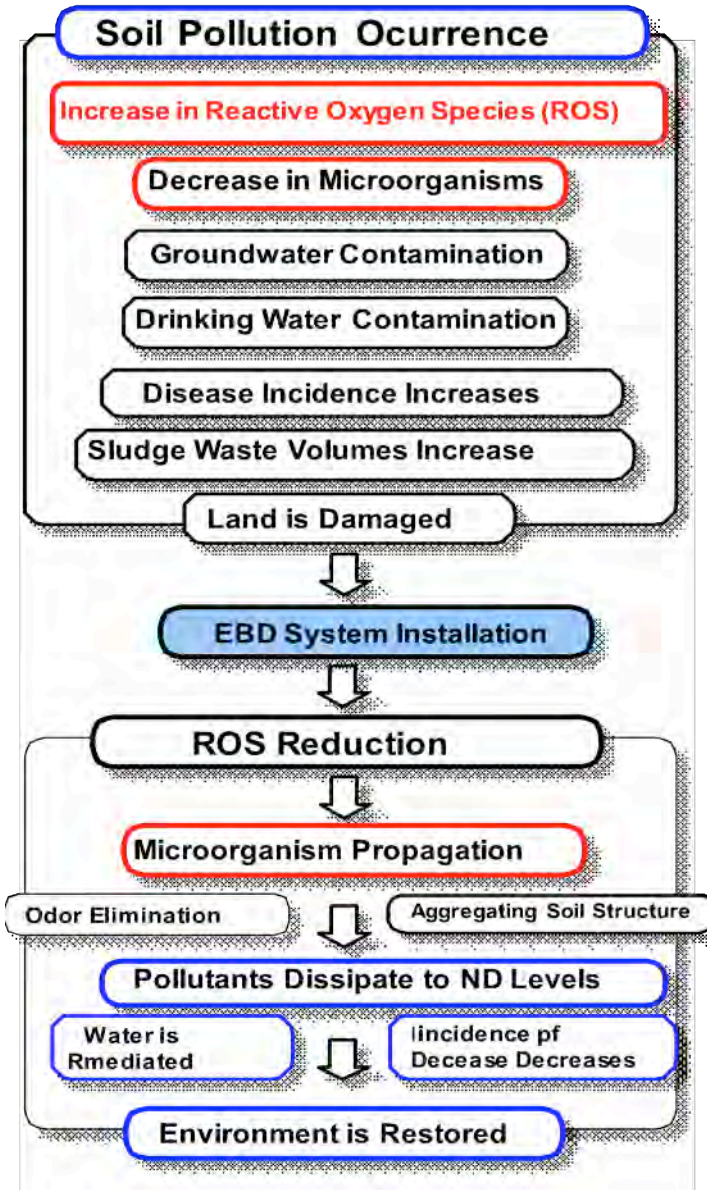
Element transmutation is achieved due to an EBD balanced environment where entropic energy is very high thus enabling decomposition of contaminated substances. The EBD induced element transmutation phenomenon, can be scientifically collaborated by using an **Electron Probe Micro Analyzer (EPMA).** Thus, element composition variations before and after EBD system installation, can be confirmed once the target soil and ground water areas are analyzed with EPMA equipment.

The required EBD treatment period is calculated based on how many years, the land to be remediated has been in use or developed. In the case of crude oil remediation, we would use the age of the oil well which has contaminated the site. For every 10 years of ongoing facility operation, 3 months will be required to improve soil and ground water quality. Soil and water analysis should be carried out every three months. Complete remediation will require between 6 to 18 months depending on pollutant concentrations, precipitation, pH levels, temperature, humidity, and seasonal variations.

Reactive Oxygen Species (ROS) will be converted to a stable form of oxygen (O2). EBD systems effectively enhance indigenous microorganism growth. EBD systems effectively remediate highly concentrated substances as well as multiple kinds of contaminants.

No side effects nor hazardous substances will be produced in the remediation process through EBD induced microbial activation. EBD systems effectively use indigenous microorganisms without introducing non-indigenous bacteria. It is a very safe method.

The Diagram below reflects the bio-transmutation process which converts inorganic substances and heavy metals into non-toxic substances through microbial enzyme secretions.



9) EBD Decontamination Mechanisms

Pesticides and Herbicides

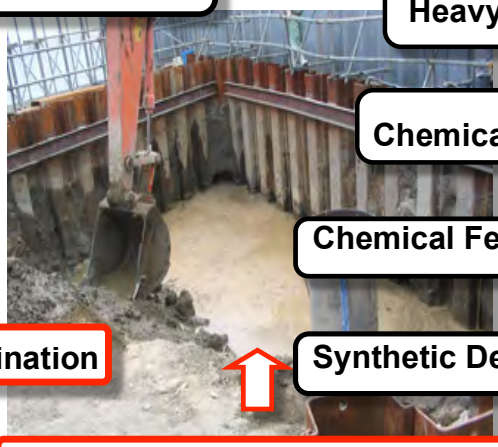
Petroleum Hydrocarbons

Chlorine Treatment Agents

Food Waste

Volatile Organic Compounds

Soil Contamination



Heavy Metals

Chemical Waste

Chemical Fertilizers

Synthetic Detergents

Increase in Negative Energy Particles (-)

Increase in Negative Energy Particles (-)

Ultra-Elementary Particle Energy Imbalance

Pollutants

- Dioxins
- Tetrachlorethylene
- Cryptosporidium
- Giardia
- Asbestos
- Chlorine
- 1,2-dichloroethane
- Lead
- Arsenic
- Mercury
- Hexavalent chromium
- Sodium
- Cadmium
- Zinc
- Mercury
- Copper
- Trihalomethane
- 1,4 - dioxane
- Trichlorethylene
- Chlordane
- PCB
- Nitrate-nitrogen
- Organochlorine compound
- Enterohemorrhagic Escherichia coli

Destruction of the Food Chain

Increase in Active Oxygen

Decrease in Microorganisms

EBD System Installation

Decrease in Active Oxygen

Increase in Extremophiles

Contaminant Digestion

Element Transmutation Enzyme Secretions

H_2O & CO_2 + Transmutation Materials

Pollutant Detoxification

EBD System Beneficial Effects

Transmuted Elements List

- Zn ⇔ Mg ⇔ CO2
- Fe ⇔ Ca ⇔ O
- Cu ⇔ Ca ⇔O
- Si ⇔ C ⇔ CO2
- B ⇔ N
- O ⇔ Cl
- Pb ⇔ Co ⇔ N
- Na ⇔ Ti ⇔ CO2
- Al ⇔ F ⇔ N
- H ⇔ Mn
- K ⇔ Ni ⇔ Ne
- Ag ⇔ Sn
- S ⇔ C
- As ⇔ He
- Li ⇔ W ⇔ Xe
- Cr ⇔ O
- P ⇔ Ne
- Hg ⇔ O
- Cd ⇔ N
- Ge ⇔ C
- Se ⇔ O
- Au ⇔ Cu ⇔ Ar
- Pt ⇔ V ⇔ He
- I ⇔ Ag ⇔ O
- Cs ⇔ Mo ⇔ N
- Ra ⇔ Au ⇔ O

10) CONTAMINATION REMEDIATION: REACTIVE OXYGEN SPECIES (ROS) vs HEALTHY OXYGEN

Bioremediation methods that use microorganisms have been extensively implemented to remediate petroleum contamination. However, the results depend largely on environmental conditions such as weather, geological features and residual petroleum aspects. Conventional bio-remediation methods are generally implemented in outdoor areas where such environmental variables are not controllable yet microbial activity which is directly affected by such variables must be controlled. Conventional Bio-remediation techniques continue to be widely implemented for petroleum contaminated sites even though the end results vary significantly. The lack of uniform and effective results is due to an insufficient amount of oxygen in the ground which in turn restricts bacteria propagation. Healthy indigenous bacteria propagation leads to an increase in microbial varieties and population densities including the types that consume oil and its derivatives. Oxygen is the electron acceptor for increasing the amount and types of necessary bacteria. Therefore, if sufficient amounts of oxygen can be introduced into the soil and groundwater where the contamination is present, the type of bacteria which decomposes oil can propagate and decompose the oil by activating and replicating naturally without having to introduce foreign non-indigenous bacteria. This is a basic bio remediation principle. From an engineering point of view however, increasing and effectively dispersing the necessary amount of oxygen in soil can be most challenging. Oxygen Release Compounds (ORC) made of hydrogen peroxide, releases oxygen and this is one of the preferred methods commonly used. The problem with ORC however is that it is: A) Difficult to disperse effectively, B) There is a limit to the depth of permeation, C) It is not effective in deep soil contamination areas and D) It does nothing to reduce microbe killing corrosive Reactive Oxygen Species (ROS) present throughout contaminated sites and this severely limits and impedes microbial propagation.

EBD systems effectively and consistently solve the soil remediation problems listed above in a clean, non-intrusive, natural and sustainable way – by using nature itself. By installing the EBD systems around the perimeter of any contaminated site, missing electrons on the outermost orbit of oxygen atoms are obtained from free electrons present in the contaminated environment. Thus, oxidizing and destructive ROS, is converted into the stable form of oxygen which is indispensable for healthy microorganism propagation. EBD makes ORC and other conventional soil remediation methods obsolete. **Regardless of the depth, type and concentrations of the target soil and ground water pollutants to be remediated, and regardless of the size of the contaminated area to be remediated, whether it be extensive or small, EBD will effectively remediate organic and inorganic pollutants on the soil surface as well as down to exceptionally deep soil depths, down to legally mandated and/or non-detectable levels.**

11) **EBD REMEDIATION FOR FUELING STATIONS AND DRY CLEANING FACILITIES**

- ◇ When a balance environment is produced through EBD implementation, radical reaction will decrease and microorganism activation will become significant in soil, leading to the decomposition of inorganic and organic substances.
- ◇ EBD remediation can easily be implemented in gas station and/or dry cleaning facilities. There is no need to excavate nor demolish standing structures.
- ◇ Installation is simple. Dig holes 30 cm in depth at intervals reflected in the Diagram below and place each EBD unit **horizontally** in each hole and then cover with top soil. Ensure that one EBD unit is buried at each corner of the area to be remediated.

If contaminated ground water extends beyond the facility, enlarge the EBD installation perimeter accordingly in order to also remediate the ground water. Polluted groundwater will be fully remediated regardless of depth so long as it is located below the EBD installed perimeter.

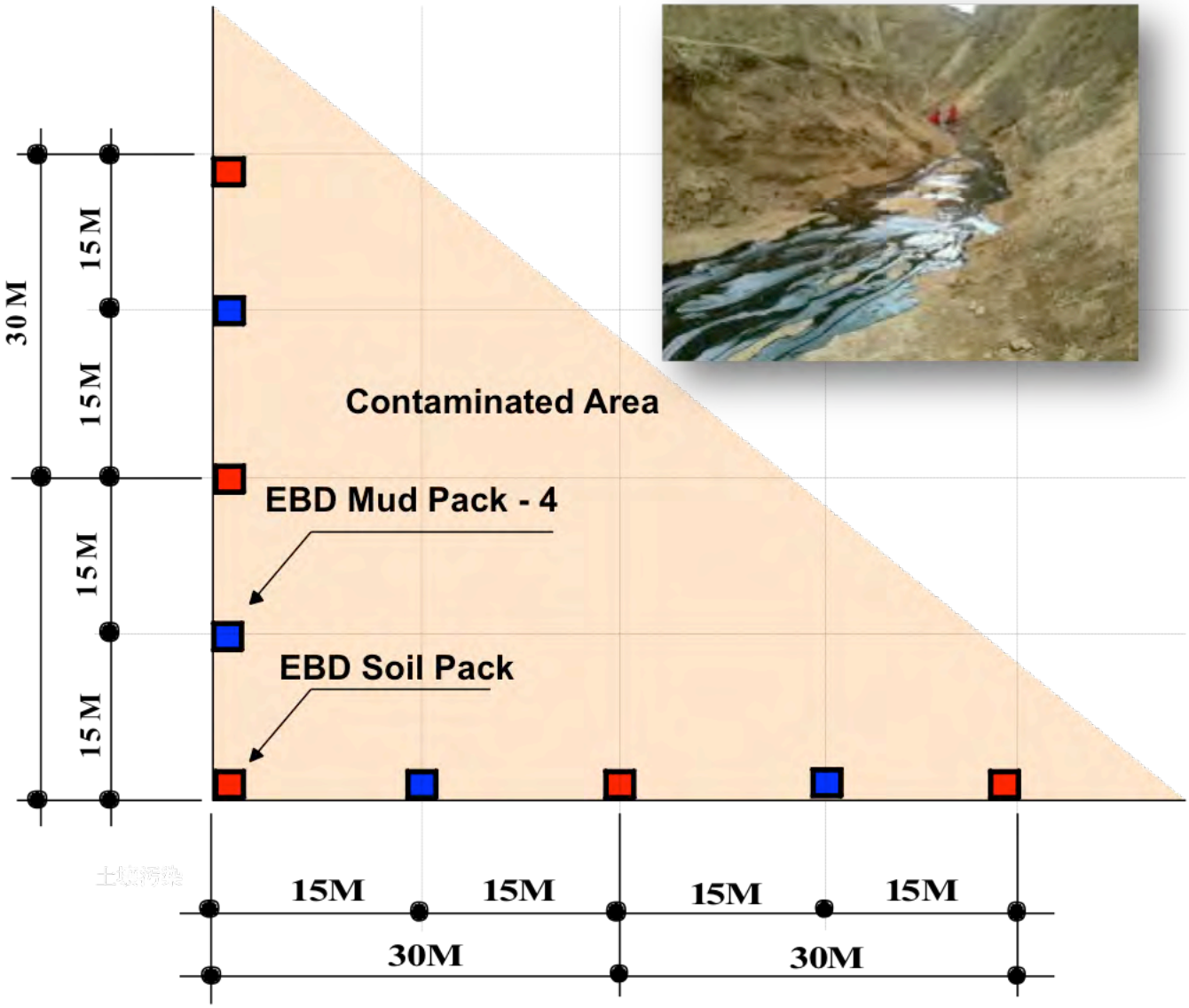
12. **EBD SYSTEM INSTALLATION ON CRUDE CONTAMINATED LAND TO BE REMEDIATED**

The Diagram below, reflects EBD system installation distances and intervals. Bury EBD Mud Pack units at 30 cm in depth, at equidistant **30 m intervals** along the outer perimeter of the tract of land or oil lake to be remediated. The size of the property to be remediated can be either quite sizable or small. In addition, also bury EBD Soil Packs at 30 cm in depth at equidistant **15 m intervals** in between each EBD Mud Pack.

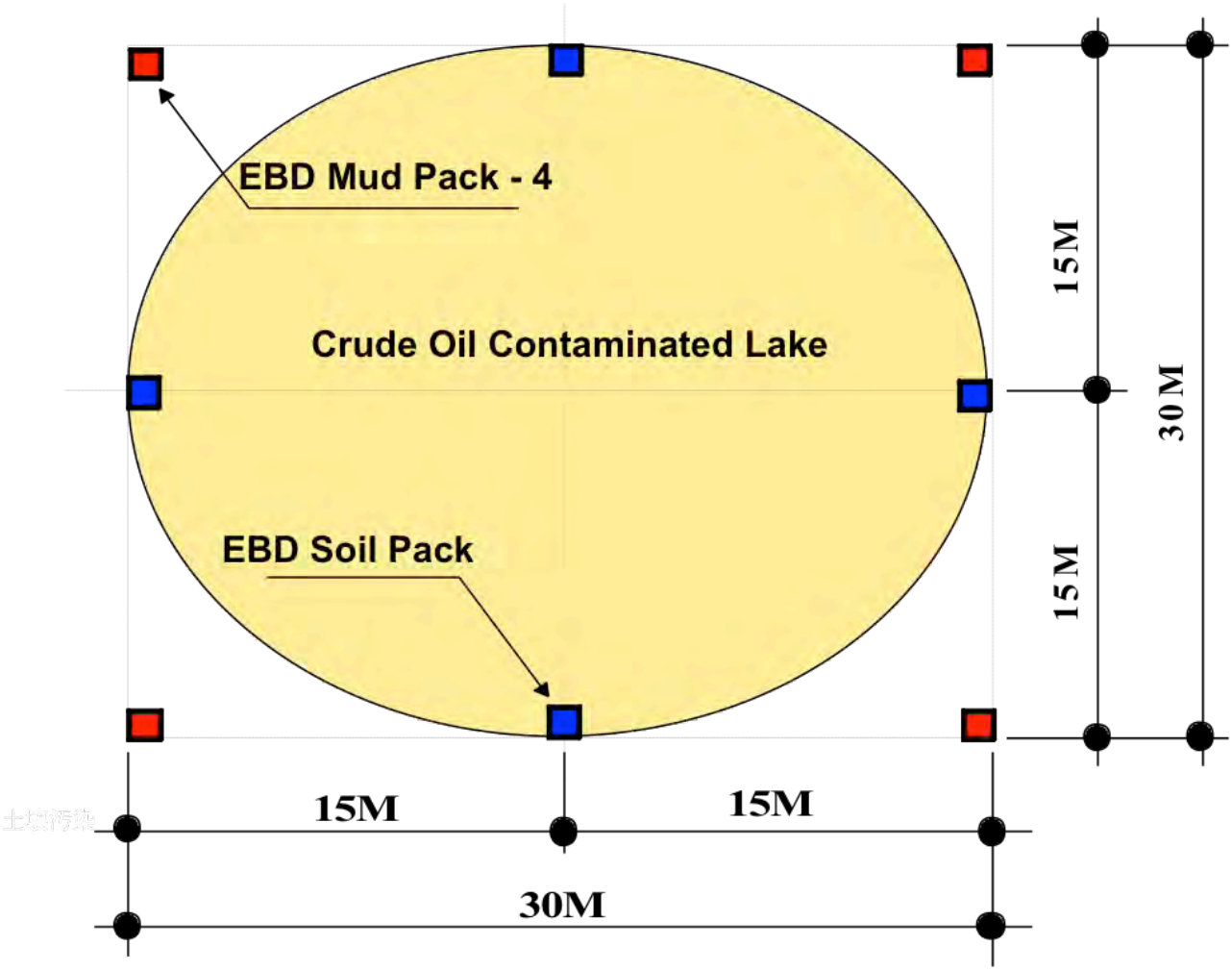
When microorganisms are killed through radical chain reactions, contamination spreads. As ROS volume concentrations are greatly deceased by EBD systems, beneficial aerobic bacteria will begin to propagate exponentially.

Once the microbial activation becomes significant, single grain structure soil will be enhanced and converted into crumb structure soil. Ammonia and methane levels which occur in anaerobic environments, will be eliminated, together with unpleasant odors. In addition, EBD induced microorganisms will seek out and consume petroleum secondary-products and heavy metals which are contained in sludge, and these contaminated substances will also be remediated by enzymes secreted from microbial bodies.

[Device Installation into Crude Oil Contaminated Lands]



[Device Installation into Crude Oil Contaminated Lakes]



- ◇ EBD Systems comply with OSHA 29 CFR XVII-1910.1200 Section (i). Contains no hazardous components under current OSHA definitions, or EPA listing. This material contains NO ingredients that are on the NPT list or registered with IARC for carcinogens and the material mixture tested as a whole has been found to be:
- ◇ • Nontoxic • Non-corrosive • Not an irritant • Not a sensitizer in oral, dermal and ocular tests (see Federal Hazardous Substance Act 16 CFR 1500) Section 3.

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