EBD TECHNOLOGY FOR OIL PIPE LINES, TANKS AND TANKERS

SUSTAINABLE SOLUTIONS TO DECREASE SLUDGE, DRAG, OIL VISCOSITY AND CORROSION

FREYTECH INC.

1111 Brickell Ave. Suite 1550 ● Miami, Florida 33131 U.S.A.
Tel. (305) 372-1104 ● Fax (305) 328-9312 ● Email: info@freytech.com ● Web: www.freytech.com
Remediation: Air, Water and Soil

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B) Reduction in sludge build up
C) Reduction in oil viscosity
D) Reduction in oil pipe and oil tank corrosion.
E) Reduction in electric power consumption to run the motor pumps given less friction and lower viscosity.
F) Increased oil flow.
G) Prolonged piping and oil tank service life
H) Reduction in pipeline and oil infrastructure replacement parts.
I) Decreases capital investment and increases profits
J) Remediates and greatly benefits the environment.

2) EBD TECHNICAL SUMMARY FOR OIL PIPELINES AND OIL TANKS (Short Version)

All matter on Earth contains positive and negative energy particles. Environments containing man-made chemicals and pollution such as in oil pipelines, contain excessive levels of negative energy particles (NEP-) and lack sufficient levels of PEP+. Excessive NEP- volumes increase oil viscosity, piping drag, iron eating bacteria colony concentrations, sludge & wax build up and are also detrimental to living organisms such as microbes. EBD units concentrate positive energy particles (PEP+) which are naturally present in the environment. By creating an energy particle balance between NEP- and PEP+ levels, all atomic frequencies of all matter situated in the oil pipelines and in the oil tanks 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 oil pipeline and tanking facilities such as, but not limited to, “streaming electrification”, within the EBD perimeter, EBD systems provide the benefits enumerated above in Section 1, in an environmentally sustainable, green and affordable way without using any chemicals and without consuming any electric power.

3) CRUDE OIL PRODUCTION PROCESSES

Generally speaking, current day crude oil production processes, entail second and third oil recoveries which inject water, gases, and chemicals into reservoirs in order to increase crude oil production and crude oil treatment thereafter.

Crude oil is pumped to the surface through tubing and the crude oil volume is adjusted by equipment on the well bore head commonly referred to, as a ***“***Christmas Tree***”***. The crude oil itself still contains impurities such as gas, water, and chemicals which must be separated. During the separation process, oil, gas, and water are separated and the weight of each component is measured. In the separation process, each substance which has a different density and weight, naturally forms their respective layers by gravity – first gas, then oil and then water. Measurement data from each process is crucial to enhance oil recovery.

A) Crude Oil & Gas Separation

If crude oil contains high levels of moisture, salt and/or sulfur, dehydration and desalination equipment is required. Free oil is separated using oil/water separator equipment and emulsified oil is separated using demulsification equipment. After these separation processes are completed, crude oil can then be transported to refineries by tankers and/or oil pipe lines.

Important indexes for crude oil properties and conditions are reflected in terms of specific gravity, sulfur content, and pour point temperature. Generally speaking, light crude oil has a low viscosity and low specific gravity due to the presence of a high proportion of light hydrocarbon fractions. Natural gas separated from crude oil can be sold or used as fuel within the oil production facility after the water, sulfur gas and carbon dioxide has been separated. It can also be reinjected into the reservoir to enhance oil volume recovery. Once the oil is separated from the produced water the contaminated water is then properly treated, and then be injected into an aquafer or discharged into the environment.

B) Gas Separation and Dehydration

Excavated crude oil from the wellbore, contains gas and stratum water which also has to be separated from the oil before it is transported. To enhance the fluid recovery ratio, separators are sometimes used in series in a step-by-step free oil separation process. When oil and water is emulsified, the fluid is either heated or demulsifiers are added to separate more efficiently.

After the oil is separated, it is pumped to storage tanks where the oil settles until the ratio of impregnated water result is such that it meets the respective buyer's contractual requirements. For oil shipments on land, pipe lines, tankers, trains and/or the combinations of these transportation methods are implemented while marine transportation employs oil tankers.

4) CRUDE OIL & GAS TRANSPORTATION

Crude tankers transport unrefined crude oil, product tankers, transport refined product, chemical tankers transport liquefied chemicals and natural gas is liquefied and transported by LNG tankers (Carriers).

A) LNG Transportation

Floating Storage and Regasification Unit (FSRU) vessels are used to transport and transfer liquefied natural gas (LNG) by sea. Floating Production, Storage, and Offloading System **(**FPSO) vessels are used by the offshore oil and gas industry for hydrocarbon production, processing and storage.

B) LPG Transportation

LPG carriers haul Liquefied Petroleum Gas (LPG) such as propane and/or butane. There are multi-purpose ships that carry both LPG and liquefied chemicals.

C) Pipeline Transportation

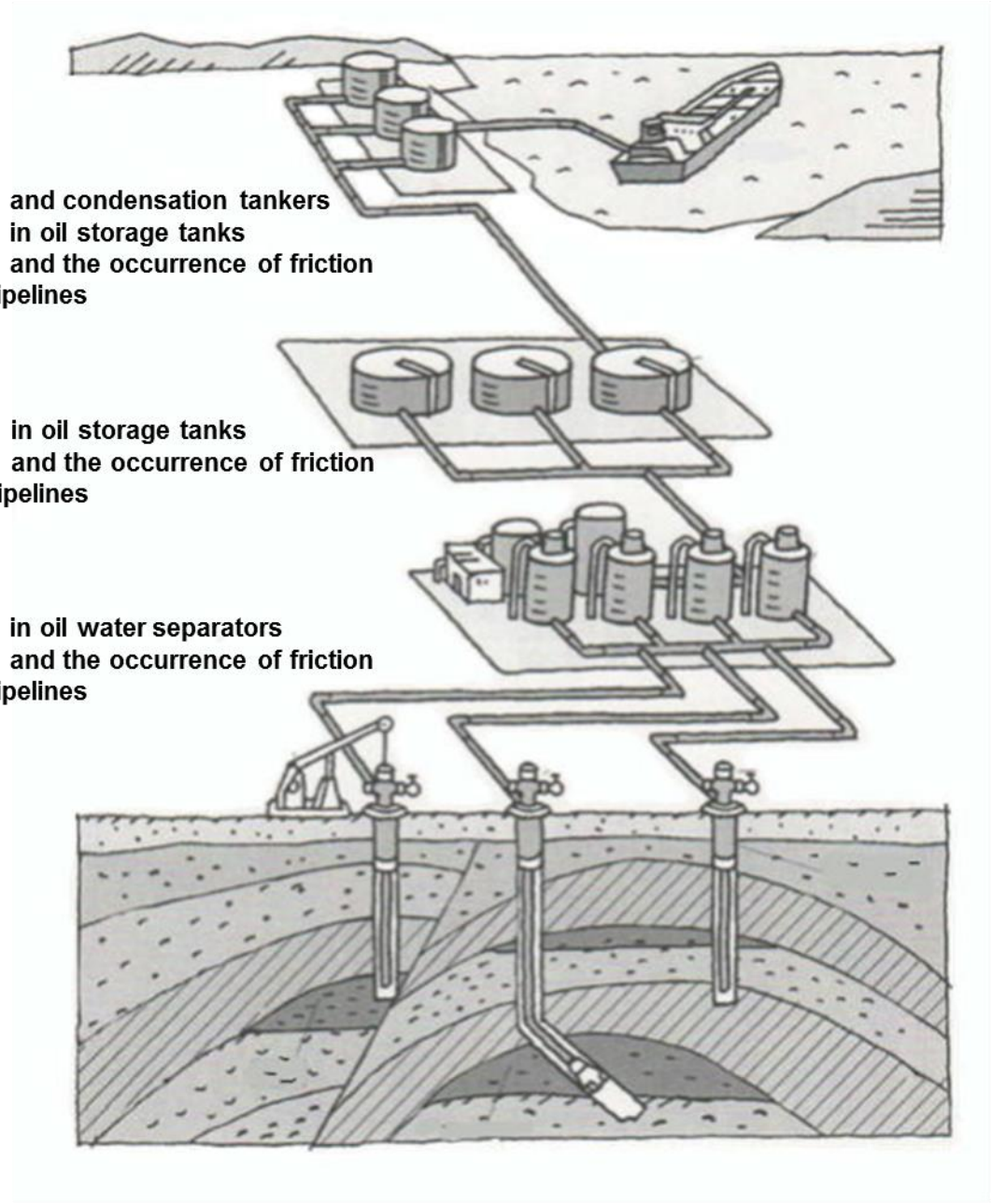
Liquids and gases are transported in pipelines and any chemically stable substance can be sent through a pipeline. Pipelines exist for the transport of crude and refined petroleum, fuels - such as oil, natural gas and other fluids.

Oil & Gas Processes and Sludge Problem
[Crude Oil Recovery / Storage / Shipment]

- Sludge accumulation and condensation tankers
- Sludge accumulation in oil storage tanks
- Sludge accumulation and the occurrence of friction and viscosity in oil pipelines

- Sludge accumulation in oil storage tanks
- Sludge accumulation and the occurrence of friction and viscosity in oil pipelines

- Sludge accumulation in oil water separators
- Sludge accumulation and the occurrence of friction and viscosity in oil pipelines



5) OIL-IMPREGNATED SLUDGE FORMATION

Crude oil is generally brought to the surface by primary, secondary and tertiary processes. Sea water is poured into offshore wells and surface water or well water is poured into onshore wells to raise the crude oil pressure and force it to the surface.

During this process, metallic ions contained in the seawater, surface and well water, are converted into solid substances. Thus, calcium sulfate, barium sulfate, strontium sulfate, or calcium carbonate bonds to the inner pipe surfaces.

Processes for the extraction of liquefied petroleum gas (LPG), gasoline, kerosene, light oil, and chemical materials (naphtha) from crude oil, is carried out in the refineries. The biggest obstructive factor is clogging in the piping and equipment and the reduction of the heat exchange rate caused by the built up of scale and sludge.

Paste-formed sludge accumulates at the bottom of oil tanks and/or in the refinery equipment. Oil, water, or soiled substances are generally mixed in the paste-formed sludge. Soft type sludge has a gruel like consistency while hard-type sludge has a thicker consistency resembling that of peanut butter. Sludge in crude oil is comprised of petroleum, water and solid inorganic substances. Sludge is neither originally floating in the crude oil nor it is present in the sedimentation of solid substances. It is generated through the chemical reactions of wax and asphallenes dissolving in crude oil, which are precipitated and gelatinized.

A) Oil-impregnated Sludge Accumulation

Sludge components include wax, water, asphallene and iron rust and their respective concentrations are higher than crude oil so they physically precipitate. Sediments precipitate in liquid, thus large-sized and high density sediment sinks to the bottom layer of the sludge.

However, some solids in water cannot precipitate to the bottom, even if they have high density with minute sized particles. In addition, the degree of precipitation may be interrupted by crude oil heat convection, high viscosity in cold climates, or electrostatic repulsions. If the particles are minute in size, some sludge components, do remain in the crude oil. In addition, crude oil temperature fluctuations cause deposition / dissolution in wax particles and this alters and greatly decreases their particle size. Moreover, if wax gels can be deposited from crude oil, they contain crude oil substances with a similar density and do not precipitate.

In addition, water used in cold climates has small water particles size. Varying temperatures in each tank for each industrial process, causes the sludge to accumulate in ridge like formation instead of in uniform flat layers. In summary, sludge formation involves numerous complex factors.

B) Conventional Oil-Impregnated Sludge Treatment Methods

In order to reduce oil impregnated sludge comprising mainly of wax and water, the common method is to heat, stir, and/or add chemicals. These methods aim to reduce the amount of sludge by the solubilization of the oil components. Emulsifying the crude oil components, or stirring the precipitated sludge, in order to diffuse it in the crude oil, is very effective. However, water-impregnated sludge which contains a large amount of water, is difficult to solubilize once it precipitates and forms sludge layers, thus it is necessary to heat it using hot water or steam. Solubilizing the bottom formed sludge which has already precipitated in the tank, is treated by washing with hot water containing oil or surfactants.

Used wash water discharged from fuel refining processes, contains a large amount of oil and it is generally treated using the activated sludge method; however, the wet refinement method discharges extremely high concentrations of BOD (approx. 80,000~130,000g/l) which is difficult to treat using the active sludge method. Oil-impregnated wastewater, therefore, is either incinerated with glycerol waste

fluid or diluted water must be used for methane fermentation.

Whichever sludge treatment method is employed however, the biggest problem is that suitable treatment methods have not been developed which can effectively treat sludge within a short amount of time. Most sludge is incinerated or taken to land-fills after dehydration. There are additional methods employed in developed countries but the capital investment required, can be prohibitive.

6) EBD TECHNICAL SUMMARY (Long Version)

EBD Technology is based on the presence of certain concentrations of ultra-elementary particles in the air/atmosphere (+) and in the earth's crust (-). It is well known that the conducting and rotating metals present at the core of our planet earth emit negative energy particles upwards which create the force field around our planet and contains our atmosphere on Earth. For purposes of this summary, we term this (-) charged emission as "the forces pushing upwards". It is also well established, that positive energy particles from the stratosphere are emitted down towards the surface of the planet. For purposes of this summary, we term this (+) charged emission as "the forces pushing downwards".

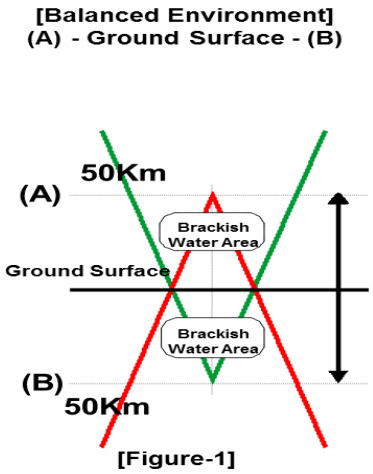
We hypothetically name the ultra-elementary particles which are present in the atmosphere as "Concentration of Positive Particles (**CPPs+**)" and the ultra-elementary particles which are present in the earth's crust (core), as the "Concentration of Negative Particles (**CNPs+**)".

The CPPs (+) in the atmosphere are the forces pushing downwards and the CNPs (-) in the earth's crust are the forces pushing upwards. They meet and mix above the ground and at sea level on the earth and affect the global environment. In a pristine and unpolluted ecosystem, the concentration balance between the two sets of elementary particles should be equal or close to it. This basic principal can also be applied to oil, sludge, and piping materials which are composed of elementary particles and which have forces pushing upward (-) from within their molecules.
The force pushing upward (-) from the Earth's crust differs depending on the areas and depths of the crude oil excavation, along with the oil's components and properties. The force pushing upward (-) increases when the CNPs (-) from the earth's crust increase and thus the crude oil and sludge accumulates on the inner walls of the piping and plumbing in accordance with the concentration level of the CNPs (-) present from the Earth's crust.

During the crude oil transportation process, kinematic viscosity is forced towards the crude oil and streaming electrification is caused by the friction created between the inner wall surface of the piping and the stream of the crude oil. This leads to a decrease in the velocity of the crude oil and an increase in the accumulation of sludge. Heavy and large particles which flow within the piping walls cause streaming electrification.

To better illustrate the "Concentration of Positive Particles (CPPs+)", regard it for a moment if you will, as if it were "fresh water" flowing down stream and regard the "Concentration of Negative Particles (-) (CNPs+)" as if it were "sea water" flowing upstream with both types of water mixing/ permeating together (see Figure 1, Areas A & B below). Within the 100-km area between areas A & B, both CPPs (+) and CNPs (-) are mixing to form "brackish water" as it were.

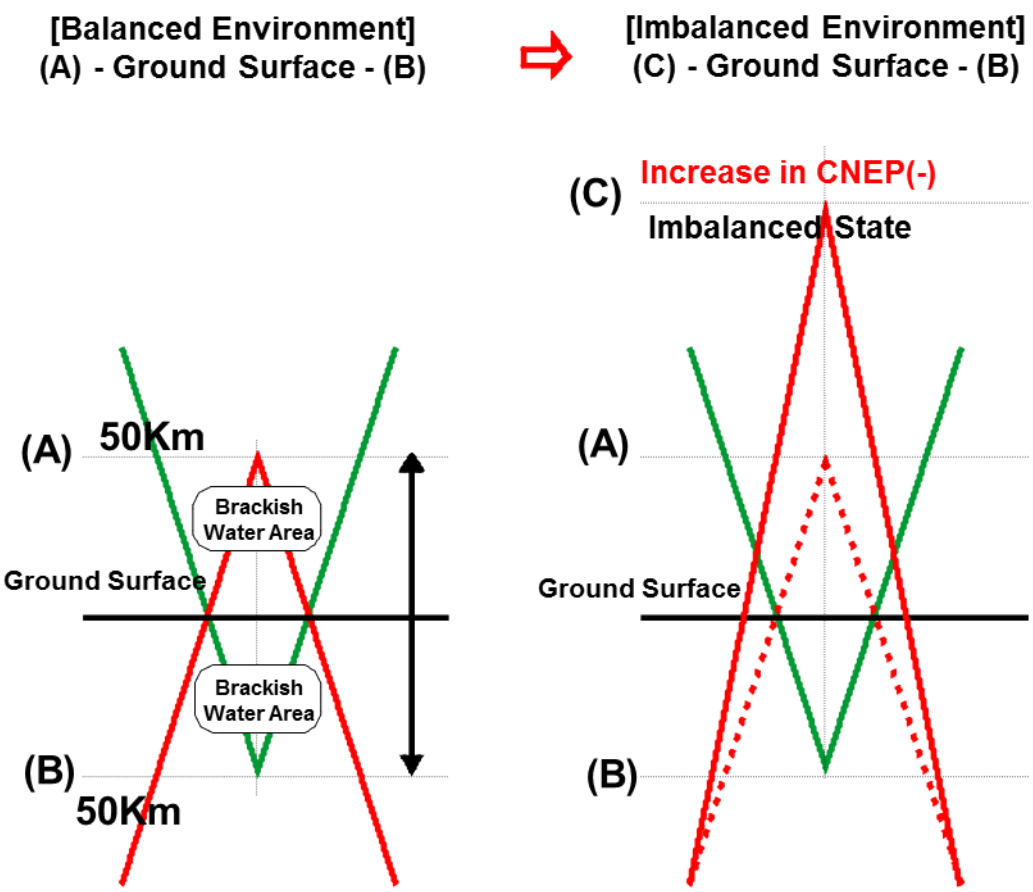
When both the CPPs (+) and CNPs (-) are equally mixed, as shown in Figure 1 below, it is known as a “Balanced Environment”. This situation resembles the osmotic pressure (the Van't Hoff's law) and under the balanced environment, entropy energy is very high. Our planet exists metaphorically in a “brackish water area”. All life, matter, and phenomenon on Earth are affected by both the CPPs (+) and CNPs (-).



[Figure-1]

7) CREATION OF IMBALANCED ENVIRONMENTS

To date, mankind has achieved remarkable progress but such advancement has also created a number of problems such as overpopulation, resource depletion, environmental contamination, use of vast quantities of chemicals which all together, have led to an alarming increase in CNPs (-) concentrations. CNPs (-) concentrations emanating from the Earth’s crust have increased and reached/exceeded over 50 km upwards into the airspace (Figure 2, below, Line C in Diagram on right hand side). When either concentration of particles (+ or -) increases, entropy energy decreases and under such an imbalanced environment, atoms enter an unstable state. This unstable situation where the concentration between positive (+) and negative (-) particles is not equal, is called an “Imbalanced Environment”. Under an imbalanced environment, all atoms which compose all substances are negatively impacted. Normally, paired electrons which rotate on the outermost orbit of an atom’s nucleus are in stable form. In an imbalanced environment, however, where the CNPs (-) increase, this results in an electron spinning off from the outermost orbit of the atom’s nucleus due to ultraviolet rays, electromagnetic waves, chemicals, acid rain, and/or high temperature (global warming).



A single electron state on the outermost orbit is known as an 'unpaired electron' and is also called a 'free radical'. A free radical tries to stabilize itself by taking one electron away from other atoms. This is called a "radical chain reaction" through highly activated strong atoms. The presence of free radicals, including super oxidant and hydroxyl radicals in the Reactive Oxygen Species (ROS) results in significant decrease in nature's natural purification processes.

8) EBD TECHNOLOGY FOR CRUDE OIL PIPELINES

All crude oil excavated from below ground is replete with CNPs (-) from the Earth's crust. Crude oil viscosity rates change when it is forced out above ground where CPPs (+) is present. Regarding the excavated crude oil molecules in the oil pipelines, the force pushing upward (-) from within the molecules is higher than the force pushing downward (+) to the surface of the molecules. The concentration balance between the two sets of forces (+) (-), greatly affects the viscosity rate in the crude oil. In addition, when the crude oil molecules contact CPPs (+), it causes streaming electrification since the crude oil was previously buried with CNPs (-) present in the Earth's crust.

Sludge is composed of wax, water, asphaltene, earth, sand, iron and rust and these components have higher densities than those of crude oil. That is to say, they are composed of a higher concentration of negative particles (-) which have a greater force pushing upward (-) than that of the crude oil. This is a reason why they convert and form sludge.

Piping materials are made of minerals which are extracted from the Earth's crust. They are composed of a high concentration of negative particles (-) which have a force pushing upward (-). This facilitates

contact with the Reactive Oxygen Species (ROS) surrounding the crude oil and piping materials and also increases piping and plumbing equipment deterioration (wear and tear).

By installing the appropriate type and number of EBD units around the crude oil pipes, high oil viscosity and sludge accumulation caused by streaming electrification and changes in the rate of viscosity will be reduced. The degree of friction present in the oil pipeline will also vary according to the molecular differences present in the individual properties of the crude oil. This is due to the fluctuating flow direction of the crude oil molecules not being in parallel with the same direction as the oil liquid flow being exerted by the oil pump.

By producing a balanced state using the EBD systems, the frequency of the crude oil molecules will be excited by the concentration balance between the force pushing downward (+) and the force pushing upward (-). Once both sets of positive and negative forces are balanced or close to becoming balanced, the molecular frequency will increase. This results in less friction being generated and oil viscosity being reduced.

By installing EBD systems and thus causing an increase in crude oil molecular frequency, the volume of sludge will be reduced. This is because the ROS which is present in and around the crude oil will not be able to easily bond with the sludge components. In addition, oil pipeline corrosion is caused in part by hydrogen embrittlement through hydrogen sulfide that may cause hydrogen-induced cracking. Rust build-up caused by the combination of the metallic piping materials and ions will also be reduced. High oil viscosity and reduction in streaming electrification caused by friction will significantly decrease regardless of the type of crude oil involved.

By increasing and optimizing the frequency of the crude oil and sludge molecules, crude oil will flow far less impeded and oil production will increase. In addition, sludge accumulation will be decreased, as will the incidence of rust thus significantly prolonging oil well equipment and piping service life. This is turn will also conserve electric power and CO2 emissions will be dramatically reduced during the crude oil production process.

9) OIL-IMPREGNATED SLUDGE AND ENTROPY ENERGY

Energy concentrations present in between the atmosphere and Earth's crust figuratively described above as the "brackish water area", is always in a constant state of change. When crude oil is extracted from the deep Earth's crust, the CNPs (-) are very high. Entropy energy will increase, after crude oil is mixed with air, sea water or fresh water, whose energy contains CPPs (+). During the refining process, entropy energy will decrease and the CNP (-) will increase, due to the artificial processes carried out such as heating, cooling and pressurizing. These low entropy states lead to producing an environment where metallic ions mingle in the crude oil. One of nature's functions is to stabilize the concentration of energy in the natural environment. Nature's self-cleaning functions however, require a high concentration of entropy energy. Microorganisms cannot adequately propagate under a low entropy concentration such as is present at oil refineries. That is why artificial sludge treatment methods such as chemical treatment or distillation are required instead.

10) OIL-IMPREGNATED SLUDGE EBD TREATMENT

EBD Systems equalize the concentration of energy density between the atmosphere and the Earth's crust, which is an indispensable process. In order to produce a stable situation, an appropriate number and type of EBD devices need to be attached to the oil pipeline as well as the oil storage tanks.

Freytech offers two distinct sludge treatment methods, both employing EBD technology.

The first method involves the decomposition of the accumulated sludge through EBD enhanced indigenous microbial processes which will convert and transmute the sludge components into water and carbon dioxide and to then further treat the resulting water with EBD systems to comply with, and meet local environmental standards for discharge. The EBD induced element transmutation phenomenon, can be scientifically collaborated by using an **Electron Probe Micro Analyzer (EPMA).** Thus, element compositions before and after the EBD system installation can be confirmed once the target soil water areas are analyzed using an EPMA.

The second method, involves the operator adding coagulants into the sludge storage tanks in order to aggregate the sludge. This second method aims to reduce the wastewater contamination level by separating the aggregated sludge. After the contamination levels are reduced, the wastewater can then be treated by the EBD enhanced indigenous microorganism decomposition processes to meet local environmental standards and thereafter be discharged to the environment or to sewer. The dehydrated sludge, which has aggregated on the bottom of the tank, can be used for biomass fuels, road building or brick manufacturing.

EBD systems are used in both of these sludge treatment methods. The function of the EBD units is to increase the CPPs (+), which affect the surrounding environment where the increased CNPs (-) has led to environmental contamination. Once the EBD systems are installed around the sludge tanks, both energy concentrations (+ and -) will equalize over time. It will take approximately 6~12months but this time range will also depend on the CNPs (-) concentrations present at the time of EBD system installation.

Indigenous microorganisms will begin their activation once the energy concentration in the sludge tank has become balanced through the installation of the EBD systems. There are classes as extremophiles (microbes) such as Archaea, Pseudomonas aeruginosa, Thermophiles, Methanogens, Sulfate-reducing bacteria, and Lactobacillus, which exist in the natural environment. The reason why extremophiles are not able to normally decompose sludge, is that both types of (+) and (-) energy concentrations are imbalanced and entropy energy decreases in such imbalanced areas. It is, therefore, necessary to increase entropy energy in order to create an environment in which extremophiles can propagate exponentially. Such microorganisms will produce bio-surfactants and during the sludge decomposition process, the kinds of anaerobic bacteria and aerobic bacteria described above, will act in unison.

11) EBD TREATED SLUDGE: TARGET VALUES

Microbial activation will greatly accelerate when both energy concentrations (+&-) are equilibrated and BOD values will thereby decrease. Assuming a high BOD value in the waste water ranging between 80,000~130,000mg/l, EBD systems will reduce it down to 1,000– 2,000 mg/l and this partially treated water can then be pumped to EBD treated waste water aeration tanks for additional treatment. With additional EBD treatment and aeration, the BOD levels can be further reduced down to 30 mg/l. This enables oil well operators in most developed countries, to discharge directly to the environment without causing environmental contamination.

Sludge solutions containing nitrogen, phosphorus, potassium, calcium, magnesium, organic carbon, volatile organic substances, metals, and ash content they can be detoxified through the bacteria's biosynthesis.

The dissolved substances in the sludge solution are not natural to the environment. The contaminated substances, which previously did not exist in those combinations and in that environment before, can be eliminated by indigenous microbial digestion processes which are now greatly facilitated by the EBD systems having caused the necessary increase in entropy energy.

12) OIL-IMPREGNATED SLUDGE DECOMPOSITION RATE

The decomposition speed of hazardous substances in oil-impregnated sludge is very important for sludge treatment. Whether coagulants are used or not, entropy will increase in the EBD treated sludge tanks, and indigenous microorganisms will begin their activation after the CPPs (+) and CNPs (-) attain equilibrium.

Microorganisms continually adapt accordingly to each of their specific environmental situations such as the state of sludge/wastewater tanks until a state of equilibrium is achieved. In other words, they will learn the structure, the amount of oxygen, temperatures, the amount of water, and the atmospheric variations in the tanks. This is similar to how viruses react when they mutate and develop resistance to antibiotics. Microorganisms exist on Earth in order to stabilize the global environment, and they have extremely complex functions to assist with various kinds of contaminants.

Microorganisms function to prevent the invasion of unnatural materials into their environment and the energy concentration balance is also maintained by their activation.

Once EBD systems have brought about the necessary energy balance and the indigenous microorganisms present in each tank have adapted to their environment, the microbes will decompose the oil-impregnated sludge in about 24-30 hours on an ongoing flow through basis, 24 hours a day, 7 days a week. The EBD target value of BOD is under 1000mg/l. Bear in mind however that entropy energy levels vary from place to place as do CNPs (-) levels and water type and concentrations in the oil-impregnated sludge. These factors have significant influence on the amount of time it will take the EBD systems to attain the necessary balanced state.

13) SLUDGE ACCUMULATION AND VISCOSITY PROCESSES

Liquids, solids, and mist-like substances produce static electricity through collusion, friction, and ablation. Regarding the electric charge, the interfaces between liquids and inner pipe surfaces, such surfaces are generally negatively charged. Pollutants, scale, and sludge are charged positively. And are, therefore, attracted to the negatively-charged inner pipe surfaces.

Insoluble and low electrical conductivity substances such as oil, easily accumulate static electricity. This electric charge phenomenon occurs when substances create friction. In particular, when low electric conductivity substances such as crude oil, are transported through pipes, such an electric charge phenomenon occurs. It is known as “streaming electrification”. When fluids from substances such as water, oils, and gases flow, internal friction occurs towards the fluids. This is a viscous property. When the strength value is included in the viscous property, it is known as “viscosity”. Viscosity can be classed as absolute viscosity and kinematic viscosity. Crude oil viscosity is usually classified as “kinematic viscosity”

Viscosity is a very important element for the crude oil reservoir performance, for crude oil transportation processes through pipelines and for petroleum products properties. It is also very important relating to the performance of drilling mud fluid (usually water) circulating in the drilling wells.

Generally, fluid viscosity decreases in accordance with a rise in temperature and gas viscosity increases in accordance with a fall in temperature. Oil and gas viscosities increase when pressure rises.

The viscosity of oil in reservoirs changes depending on the composition of the crude oil. For example, when the force of gravity or the size of the oil molecules is large, oil viscosity increases. It also changes depending on the temperature and pressure in the oil reservoir along with the amount of dissolved gases present. Changes in pressure alone cause only a small change in oil viscosity although viscosity increases as pressure increases as indicated above.

In general, petroleum viscosity is expressed as kinematic viscosity by dividing the absolute viscosity of the fluid with the fluid’s mass density. The international unit of kinematic viscosity is expressed in mm^2. Hydrocarbon viscosity increases in accordance with the series of compounds when the molecular weight increases.
Petroleum viscosity decreases in accordance with a rise in temperature. The Viscosity Index (IV) is often used to characterize viscosity changes in relation to temperature in lubricating oil. The VI scale was set up by the Society of Automotive Engineers (SAE). The temperatures chosen arbitrarily for reference points are 100 and 210 °F (38 and 99 °C). The original scale ranged between VI=0 (the lowest VI lubricant oil based on the grade of lubricant oil from the Gulf of Mexico) and VI=100 (best lubricant oil VI based on Pennsylvania Grade Crude Oil). The higher the VI, the smaller the amount of viscosity changes in relation to temperature.

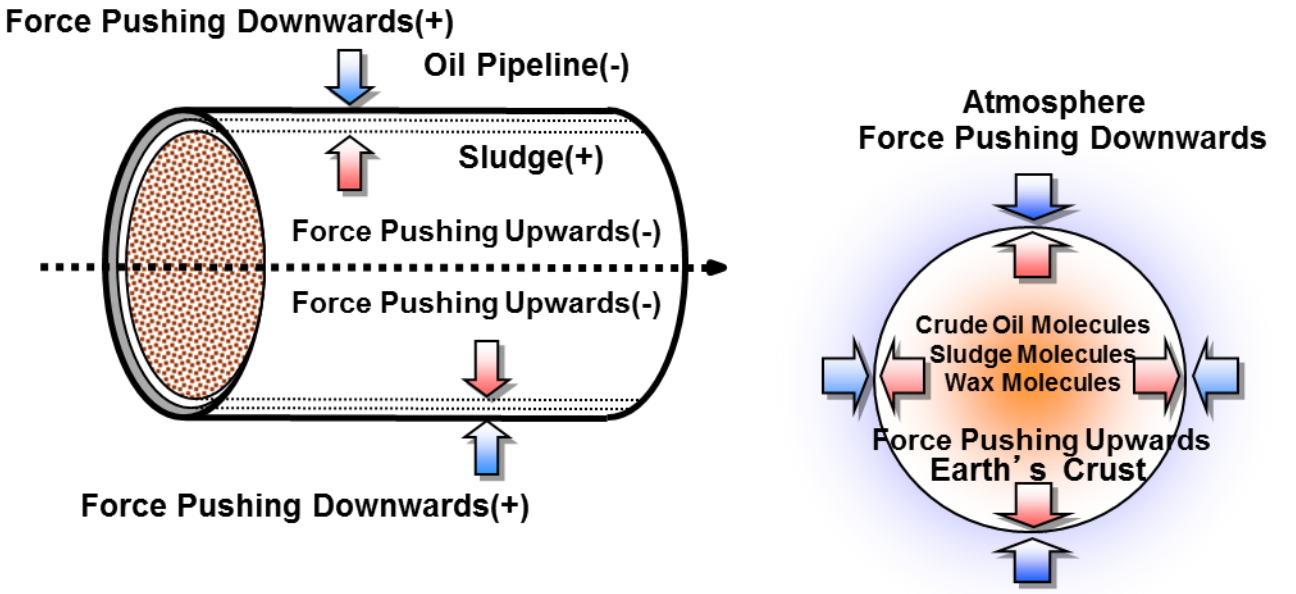
As already indicated, sludge accumulation on the inner surfaces of the oil pipeline is caused by streaming electrification and/or the kinematic viscosity of the crude oil, and as it builds up, it decreases the crude oil flow. The reduction in the amount of oil transported also causes wear and tear on the transportation pipes and leads to increases in cleaning costs, replacements, sludge treatment, and electrical power consumption.

Crude oil is conveyed through pipes by oil pumps. The components of crude oil-impregnated sludge include wax, water, asphaltene, soil, sand, and iron rust whose densities are higher than the crude oil itself., These components, therefore, accumulate on the inner wall surface of the pipes.

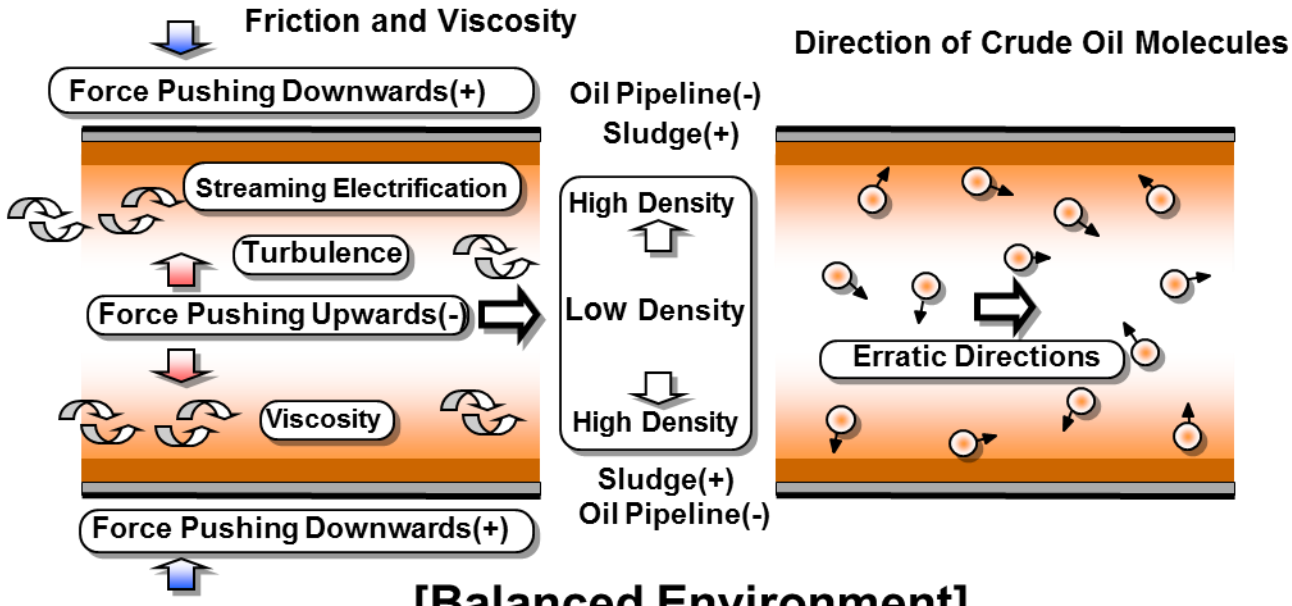
However, it is not always the case that all components and/or moisture accumulate on inner pipe surfaces. Even if substances have high-densities with minute particles under 10μm in size, their accumulation speed is extremely slow, and thus under such conditions, crude oil heat convection, increase in viscosity in the cold climates and the repulsion of static electricity, may suspend the accumulation of the above-mentioned substances on the inner pipe walls. In conclusion, the larger the fluid particles are, the slower the speed of transportation will be due to their heavy weight. The transportation speed will be faster with minute particles due to their lighter weight. Thus, the minute particles can flow smoothly in the center zone of the pipe even though they have the potential to become sludge. When shale gas and/or oil excavation is carried out, hydraulically pressurized fracturing liquid (made from water) containing gravels, hydrochloric acid, preservatives, gels, and friction reducing agents is injected into the oil well/s. Then, the fracturing water is mixed with shale gas and/or oil and it is forced out from the oil reservoir together with the oil and gas from the pressure exerted by the fracturing water. The chemicals which are contained in the fracturing water reduces friction but cause serious environmental problems as well as significant problems with the crude oil production facilities themselves.

All materials contained in EBD units comply with OSHA 29 CFR XVII-1910.1200 Section (i). EBD systems do NOT contain hazardous components under current OSHA definitions, or EPA listing. The EBD materials do NOT contain any 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 US Federal Hazardous Substance Act 16 CFR 1500) Section 3. Physical & Chemical Characteristics. EBD systems do not contain any flammable materials, are explosion proof and do not cause any electromagnetic interaction

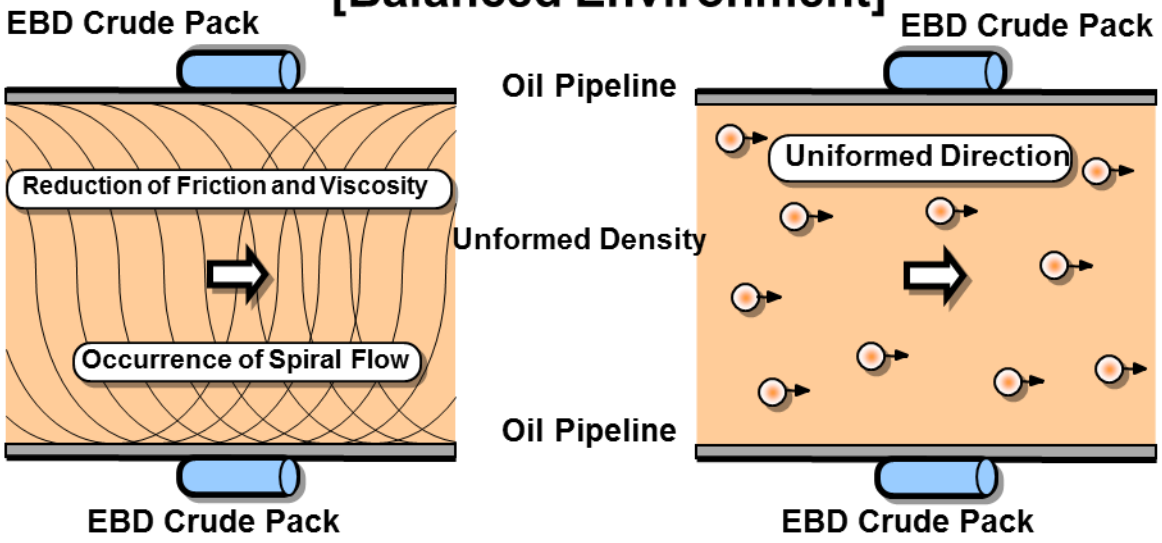
14) CRUDE OIL AND SLUDGE VISCOSITY DIAGRAM



[Imbalanced Environment]



[Balanced Environment]



15) EBD CRUDE PACK SELECTION CHART ACCORDING TO PIPE DIAMETER AND FLUID TEMPERATURE

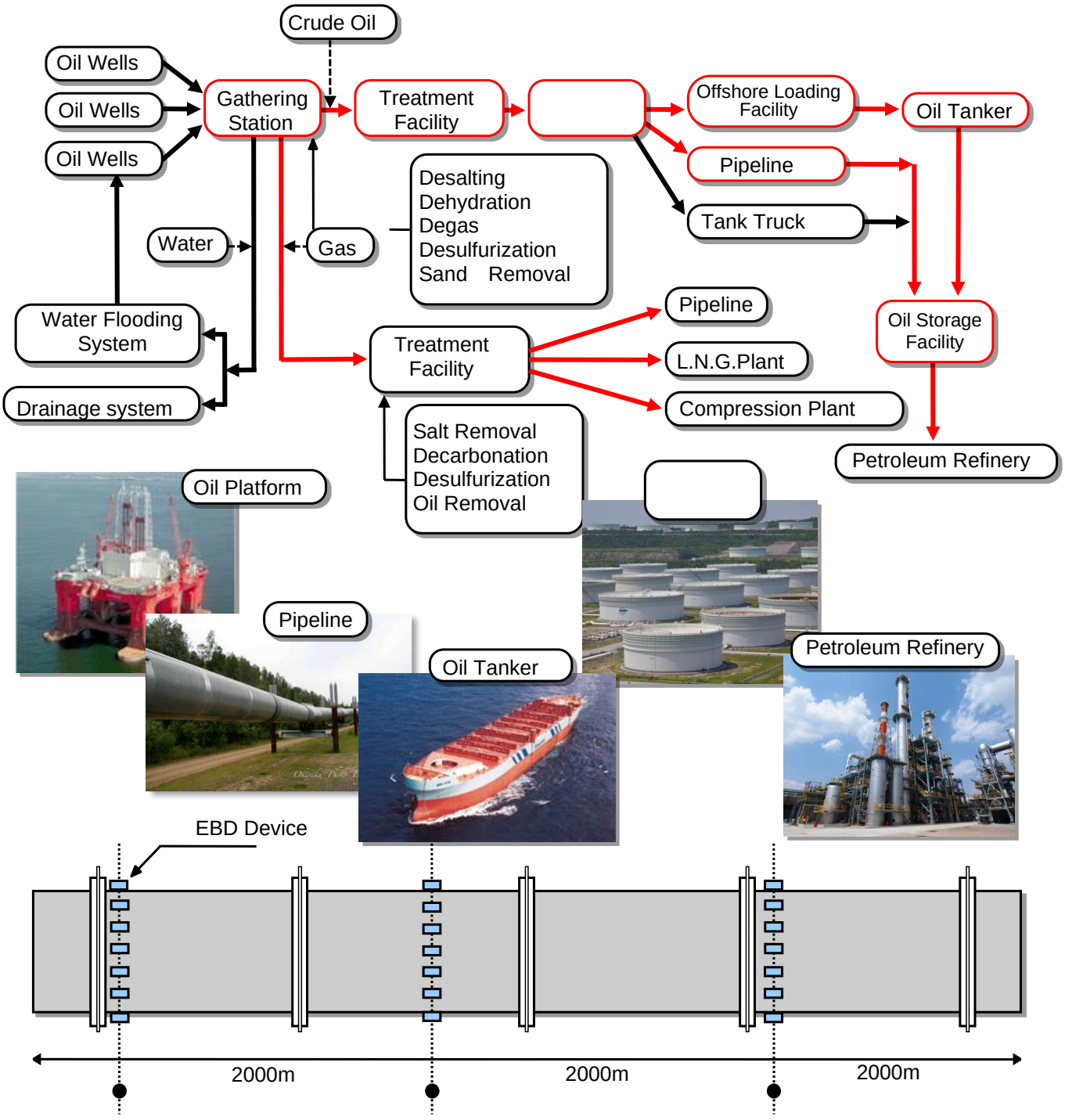
mm(A)	Inch(B)	Device (80℃-Under)	Device (80℃-or Over)
40	1×3/4	2(L)	4(L)
50	2	2(L)	4(L)
65	2×1/2	2(L)	4(L)
80	3	3(L)	6(L)
90	3×1/2	3(L)	6(L)
100	4	4(L)	8(L)
125	5	4(L)	8(L)
150	6	5(L)	10(L)
175	7	5(L)	10(L)
200	8	6(L)	12(L)
225	9	6(L)	12(L)
250	10	7(L)	14(L)
300	12	7(L)	14(L)
350	14	8(LL)	16(LL)
400	16	9(LL)	18(LL)
450	18	10(LL)	20(LL)
500	20	12(LL)	24(LL)
600	24	14(LL)	28(LL)
650	26	16(LLL)	32(LLL)
700	28	18(LLL)	36(LLL)
750	30	20(LLL)	40(LLL)
800	32	22(LLL)	44(LLL)
850	34	24(LLL)	48(LLL)
900	36	26(LLL)	52(LLL)
1000	38	28(LLL)	56(LLL)
1100	40	30(LLL)	60(LLL)
1200	48	32(LLL)	64(LLL)
1350	54	34(LLL)	68(LLL)
1500	60	36(LLL)	72(LLL)
1600	64	38(LLL)	76(LLL)
1800	72	40(LLL)	80(LLL)
2000	80	42(LLL)	84(LLL)

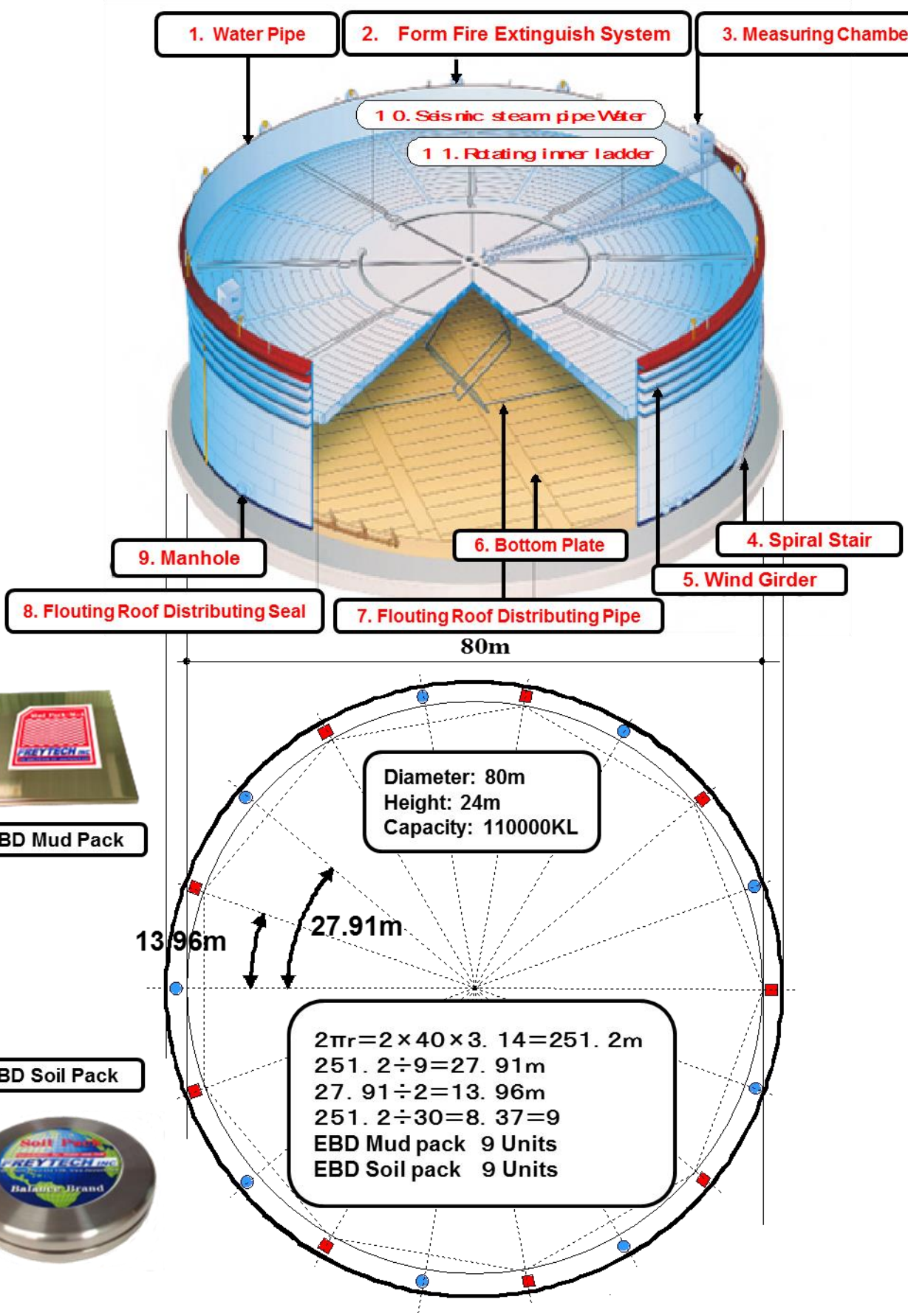
Crude Pack - L

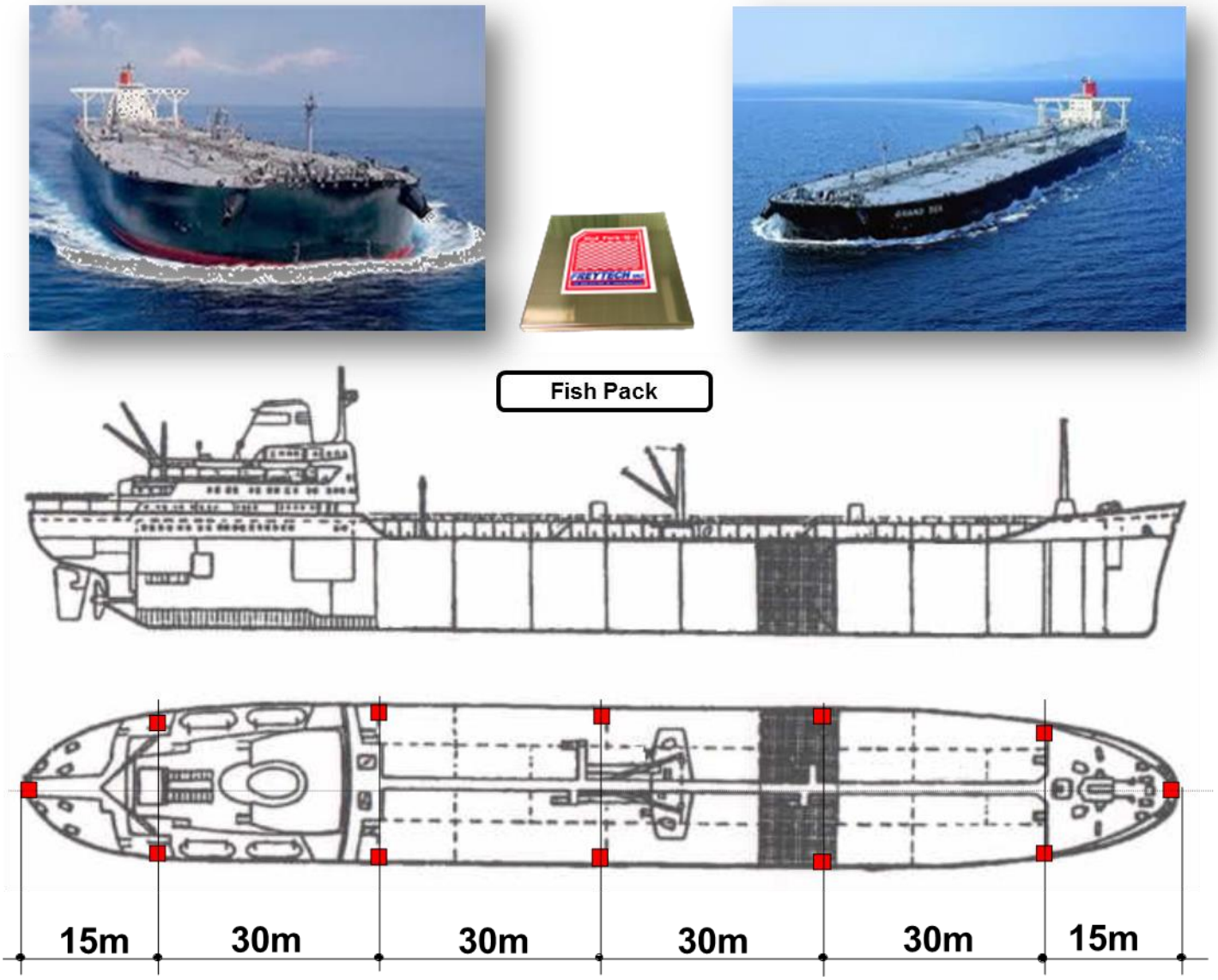
Crude Pack - LL

Crude Pack - LLL

16)EBD SYSTEM INSTALLATION ON OIL PIPELINES, AROUND OIL STORAGE TANKS AND IN CRUDE OIL TANKERS




1. Water Pipe
2. Form Fire Extinguish System
3. Measuring Chamber
10. Seismic steam pipe Water
11. Rotating inner ladder
9. Manhole
6. Bottom Plate
4. Spiral Stair
5. Wind Girder
8. Flouting Roof Distributing Seal
7. Flouting Roof Distributing Pipe
80m
Diameter: 80m
Height: 24m
Capacity: 110000KL
13.96m
27.91m
2πr=2×40×3.14=251.2m
251.2÷9=27.91m
27.91÷2=13.96m
251.2÷30=8.37=9
EBD Mud pack 9 Units
EBD Soil pack 9 Units
EBD Mud Pack
EBD Soil Pack



A) EBD Crude Pack Installation on Oil Pipelines

EBD Crude Packs should be first wrapped in insulation material, inserted into mounting brackets and then attached horizontally in ring formation to the outer wall of the oil transportation pipeline at every 2000 m equidistant interval. The number of EBD Crude Packs required, will depend on the diameter of the oil pipe and the temperature of the fluid flowing within. Please refer to the EBD Crude Pack Selection Chart above. There are a series of crude oil pipelines, beginning with the oil well pipeline, the pipeline used to transport the crude oil to the tankers, the transportation pipeline from the tankers to the refinery, and the transportation pipeline to the crude oil storage tanks. EBD systems are effective in each process involved in crude oil excavation and transportation.

The crude oil should not be exposed to the atmosphere. In other words, if the intermediate oil storage tanks exit in the pipelines, the crude oil will be exposed to air. In that case, the EBD installation interval should be recalculated again from that position moving forward.

Specific EBD devices are required for the oil collection stations, oil processing facilities, oil storage facilities, offshore facilities, tankers, oil refineries, and other oil production facilities.

The EBD units should be insulated to minimize the influence of ambient temperature, rainfall, wind, and lighting strikes.

• EBS systems are effective regardless of the pipe: a) diameter size, b) pressure, c) materials, d) temperature and d) thickness.

• EBD systems do not contain any chemicals and do not require electric power.

• When replacing old and or corroded piping, the EBD Crude Packs should be temporally removed and later reattached to the new piping once installed. The EBD Crude Packs will continue to function, but a short period will be required however, to once again produce a balance state in the newly installed pipes.

If the diameter of the pipe exceeds 600mm, please contact Freytech Inc. to confirm the necessary number and type of EBD Crude Pack required.

B) EBD Soil Pack and Mud Pack Installation Around Oil Storage Tanks

Bury EBD Soil Packs and EBD Mud Packs at 45 cm in depth around the perimeter of each oil storage tank.
Bury EBD Soil Packs in between each EBD Mud Pack.
Begin by calculating the installation interval for the EBD Mud Packs measuring the perimeter of the tank and then divide by 30m. When calculating, always "round up" the number in the EBD Mud Pack calculation. For example, in the oil storage tank diagram above, the tank has a 251.2m perimeter. The calculations are as follows:

- 251.2 ÷ 30 = 8.37 = 9 EBD Mud Packs (rounded up)
- 251.2 ÷ 9 = 27.91m
  The correct installation interval of each EBD Mud Pack is at every 27.91m around the outer base of that particular oil storage tank.
- In addition, since one EBD Soil Pack must be installed in between each of the EBD Mud Packs, the correct calculation to determine correct installation interval is: 27.91 ÷ 2 = 13.96m
  The EBD Soil Packs should be buried at 13.96m intervals in between each of the EBD Mud Packs.

• Before installing any EBD unit whether above or below ground, ensure that each one is well insulated. Avoid direct sunlight on EBD units over prolonged periods.
• The EBD units do not necessarily need to be installed below ground although this helps protect them against theft, vandalism and physical damage. If below ground installation is not possible, it is recommended that the EBD units be set in concrete above ground.
• When the tanks need to be replaced, first remove the EBD units and reinstall once the new tanks are in place. The EBD devices will continue to function, but a short period will be required however, to once again produce a balance state in the newly installed tanks.

C) EBD Fish Pack Installation on Crude Oil Tankers

• EBD Fish Packs are installed on board the crude oil tanker at 30m intervals. In addition, install one EBD Fish Pack at the stem and one at the stern followed by two units on each side of the vessel 15m away from both the stem and the stern. Please see Crude Oil Tanker diagram above.

- EBD Fish Packs are effective regardless of the vessel's cargo loading weight.
- EBD Fish Packs may be installed above or below deck. If installed above deck, water proof and insulate the units to protect them from direct sunlight and rain.

17. ADDITIONAL EBD SYSTEM INFORMATION

- ☐ The atomic frequency of the a) crude oil molecules, b) microorganisms, c) pipes, and d) dissolved inorganic substances will increase once a balanced environment is produced.
- ☐ It is estimated that increasing and stabilizing the atomic frequency of all molecules in the crude oil will require at least 3 ~ 12 months.
- ☐ The required EBD remediation period can be calculated based on the age of the pipelines. For example, if 10 years represents one unit of ongoing operation, three months will be required to decrease the accumulated sludge build up. For example, if the oil well facility is 30 years old, it will, therefore, take 3 months x 3 = 9 months for the required balance to be achieved. Once the Balance is reached, microbes will begin to replicate exponentially. Allow for additional time in low precipitation areas.
- ☐ When the atomic frequency of the crude oil molecules increases, streaming electrification and viscosity will decrease.
- ☐ When a balanced state is produced by equalizing the concentrations of the two sets of ultra-elementary particles (+) (-), an increase in the flow of crude oil in the pipeline will be induced.
- ☐ An increase in the atomic frequency of the crude oil molecules will lead to a change in the stream of molecules from a turbulent flow to a spiral flow.
- ☐ A spiral flow will enable a reduction in frictional resistance. This is due to the crude oil molecules flowing uniformly.
- ☐ When the frictional resistance is reduced, sludge accumulation will be significantly reduced in the pipelines.
- ☐ Unstable Reactive Oxygen Species (ROS) collect electrons in the crude oil. EBD systems convert ROS into a stable form of oxygen.
- ☐ An increase in the stable form of oxygen greatly facilitates microorganism propagation.
- ☐ Accumulated sludge and rust build up on the inner wall of the pipes, storage tanks and ship tanks will be gradually reduced through such EBD induced microbial activation.
- ☐ Crude oil sampling and lab analysis for EBD treated crude oil and non-EBD treated crude oil, both derived from the same oil well, should be carried out monthly after EBD systems have been installed.
- ☐ The following environmental factors greatly affect indigenous microbial activity: temperature, oxygen density, ROS density, nutritive salt concentrations, moisture levels, and pH levels.
- ☐ The speed and effects of EBD remediation will vary according to the longitude, latitude, elevation, and depth of the oil well, oil and soil quality, as well as moisture levels.
- ☐ Data values may fluctuate until the state of sludge contamination can be improved. Long-term observation will be required.
- ☐ In summary, in oil transportation applications, EBD systems reduce friction and eliminate sludge between the piping inner wall surface. Please see additional EBD brochures for other applications such as soil remediation, oil well facility treatment, produced water treatment etc.
- ☐ Creating an EBD induced balance state significantly decreases costs incurred in transporting oil.
- ☐ Reducing friction in the pipes leads to significant energy savings Reducing sludge accumulation, leads to a significant reduction in expenses incurred in purchasing chemicals / polymers, treating industrial waste and in cleaning operations.
- ☐ EBD systems will extend oil piping and oil infrastructure equipment service life, will reduce the need for consumables and the operator will need fewer replacement parts.
- ☐ Crude oil transportation costs will decrease, crude oil volumes transported will increase, and oil quality will also be enhanced.