



Total Environmental Solutions

TES TECHNOLOGIES & SERVICE OFFERINGS

<https://www.tes-applications.com/>

We provide a complete environmental solution for South America through the clean-up and recovery of waste oil and the cost effective treatment of contaminated water and solids through the application of a proven industry leading technology

April 2019

Who Are We?



Total Environmental Solutions (TES) has built a highly experienced team with international oil and gas and water treatment technical and operational expertise.

There are extensive legacy environmental problems relating to waste oil, contaminated water and solids waste that exist across all of South America. Environmental legislation is changing and authorities (ANLA) are requiring clean-up to happen. However, there is limited expertise in the region to do this.

We provide a 360 degree environmental solution for South America through the clean-up, recovery and sale of waste oil; and the cost-effective treatment of contaminated water and solids through the application of proven industry-leading technology currently in operation from the US and elsewhere internationally; we are not experimental.

Fortunately, waste oil is a valuable commodity that can be recovered and sold to create an additional revenue stream for our clients.

TES Management Team



- **Jim Bradley**, *CEO*: A petroleum engineer with over 40 years of international technical, operational, commercial and senior executive experience with BP, ARCO, Petro-Canada. A British citizen, who has lived and worked in challenging environments such as the North Sea, Middle East, North and West Africa and Russia throughout his career. In 2010 he co-founded White Rose Energy Ventures, an oil company focussed on deep water exploration in Africa and raised over \$400m of funding from US private equity houses Riverstone and First Reserve.
- **Brian Smith**, *General Manager*: Geological Engineer registered as a P.Eng. with APEGA (Alberta, Canada) and COPNIA (Colombia) and a member of the PMI, has over 30 years of oil & gas operations, management, and executive experience. He is a Canadian citizen who is resident in Colombia and actively consulting within the oil industry, with his previous positions being Project Director (consultant) for Amerisur Resources, Vice President of Operations for Petrodorado Energy Ltd. (Colombia), and Production Manager (Colombia and Peru) for Petrominerales Colombia Ltd. Mr. Smith commenced his career in field operations with Schlumberger Ltd, with technical, managerial and project management postings in Canada, the USA, Venezuela and Saudi Arabia.
- **Clark Hicks**, *Technical Director*: USA citizen and General Contractor having 25 years' experience with an emphasis in management and operations with companies specializing in remediation and treatment of hazardous or polluted waste. Including domestic and industrial waste streams, oil field produced water, frac water, tank bottoms, spills, fluid separation, desalination and water treatment. Designed, built and operated installations in Washington, Montana, North Dakota, Belize, The Bahamas and the U.A.E. Previous positions include; GM - Expert Restoration, GM- ND Waste Water Treatment, National Sales Manager - Apptech Solutions, Belize Country Manager - Belize Desalination Plant, Director of Projects– PWT Bahamas, General Superintendent – U.A.E. desalination plant build out.
- **Maarten Bruggink**, *CFO*: A qualified accountant and experienced financial executive with broad international experience in business management, corporate restructuring and financing. Maarten has invested in a portfolio of companies active in the oil, gas and renewable energy sector.
- **Paul Richards**, *Chairman* : A qualified Solicitor he spent 8 years in private practice specialising in corporate, commercial and insolvency law. He transferred to Investment Banking working for Hoare Govett, Collins Stewart and Fairfax IS. He has worked in the City for over 25 years and has a very wide range of experience of working with public and private companies across a number of sectors.

TES Key Service Offerings



Waste Oil Recovery

The incoming material from lagoons, tank bottoms or drill rigs will consist of a slurry of crude oil, tight emulsions, water, solids, asphaltenes, bitumens and polymers. TES technology separates the slurry into crude oil, water and solids. TES is developing a process unit to enable treatment of these materials at the oil company locations so payment to collection companies would no longer be required.

Key equipment components (Fixed or Mobile): OWS, Proprietary Emulsion Breakers and Polymers (USA), Heat, Residence time, Centrifuges.

Water Treatment

Produced water from the oil field operations or Waste Water (grey & black water) is treated to the contract specifications. The treated effluent can be disposed of downhole (produced water) or surface discharged (produced or waste water).

TES can meet or exceed any effluent quality specification as required by the client or by environmental legislation.

Strategic equipment suppliers are located in the USA with latest, proven and field-applied technologies.

Soil and Solids Remediation

Waste solids are bioremediated to a point that the treated material is no longer a hazardous waste. The treated, inert material may be land applied or disposed of at normal landfill rates.

Heavy Crude Oil Tanker Truck Offloading



Extra heavy crude oil can be difficult to offload from tanker trucks; especially if they do not have heated containers. TES' proprietary process, using an **exothermic organic heating additive + catalysts** can greatly assist with this process at a fraction of the time, thus increasing offloading efficiency and improved economics.

Our Process – Waste Oil Recovery



TES provides the expertise to solve legacy environmental problems relating to waste oil, contaminated water and solids waste through a rigorous up-front planning, robust execution & continuous improvement process.



TES offers a customised service for each specific treatment and project:

- ✓ **Laboratory testing** to determine the optimum treatment and process design for each waste fluid.
- ✓ **Best-In-Class equipment & chemical providers** selected based upon specific requirements for each project with some based in the USA.
- ✓ **Only proven technologies** are used.
- ✓ **Process optimised** during operations with TES experts to advise & adjust on site.
- ✓ **Continuous improvement** during ongoing operations.

TES has proven that Rubiales-type, tight emulsions can be broken to 0.7% BS&W in the US laboratory with proprietary chemicals.

TES has a 2000 bpd equipment train available now in Colombia using proven, globally-deployed technologies & processes.

Waste Oil Recovery

Current Global Operations



Total Environmental Solutions



Current Regions where Crude Recovery Companies are using proven, high technologies + stringent processes + proprietary chemistries that TES would bring to Frontera operations



Water treatment technologies, that TES would bring to client operations, are currently deployed on all continents, worldwide.

Waste Oil Recovery Value Offering & Joint Responsibilities



TES Responsibilities :

- Performs laboratory testing of field samples to optimise the equipment design & operation.
- Provides a timeline to initiate operations.
- Builds a fixed or mobile unit appropriate for the specific operation.
 - Designs, procures, pays for , constructs, installs, commissions, operates and maintains the process plant to the client's specifications and capacity requirements.
- TES treats the waste on the clients location
- Provides the personnel and the quality control of recovered oil and the treated waste water to achieve the specification every day.
 - Assures that the oil recovered from the emulsions will have the contractual sales specification of BS&W normally in the range of 5% - 0.5% (Dependent upon client requirements, input material & lab testing)
 - Returns the separated water & solids to client for treatment & disposal.
 - Treats the waste water and solids, if required, and provides assurance that the water & solids are treated to meet all required standards so mitigating environmental and reputational risk to client.
- Charges a service fee/bbl of emulsion treated and pays for all capex and opex (excluding utilities).

Waste Oil Recovery Value Offering & Joint Responsibilities



Client Responsibilities:

- Provides field samples for TES laboratory testing.
- Provides the waste material to be processed, power, tankage, space on location and permitting.
- Treats & disposes of the water & solids unless client prefers that TES assumes these roles.
- Pays a tariff to TES for the treatment of the oil emulsions + water &/or solids as required.
 - This model reduces the capital risk to the client and enables projects to move forward quickly.

Benefits to Client:

- No longer needs to pay third parties for disposal and transportation fees.
- Significant cash flow advantages as client avoids disposal fee expenses + realises revenue from recovered oil sales that can be comingled with existing sales streams.
- Waste water, oil & solids remain within its control, removing potential liabilities when handled offsite by third parties.

Waste Oil Recovery: Lab Results for a Rubiales-Type Emulsion

Raw Sample Characteristics

Oil API: 13°

Emulsion Viscosity: 247 cSt @ 25°C

Components: Oil: 28% // Water: 40% // Solids: 32%

Oil Cut + BS&W Lab Results

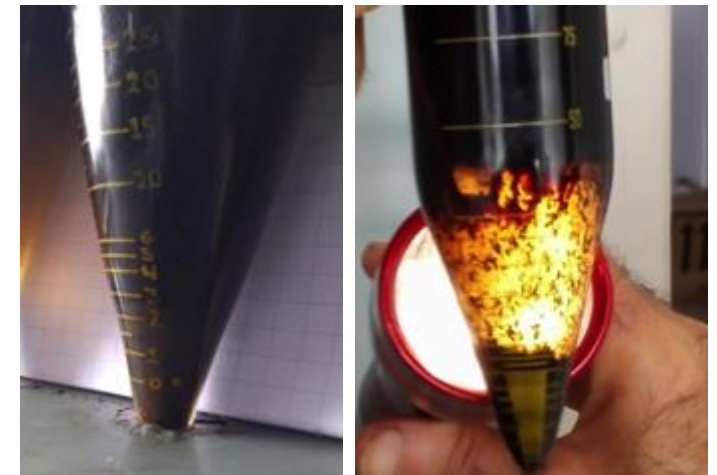
By centrifuge method				
Components	1st Spin	2nd Spin	3rd Spin	4th Spin
Oil	30%	30%	35%	28%
Ring	-	-	-	-
Water	55%	48%	48%	40%
Solids	15%	22%	17%	32%

Moisture by Karl
Fischer (3rd Party lab)

0,7%

Before: Very tight emulsion with 28% Oil + 72% BS&W.

After: Clear separation of the 3 phases with oil on top with only 0.7% water per Karl Fischer testing (rag layer interface at its bottom), water in the middle (with suspended heavier hydrocarbons), solids settled on bottom.



Before

After

Waste Water Treatment

TES Technologies and Services



Produced Water:

- TES would provide (as required) the latest, proven and field-applied technologies such as Electrocoagulation (EC), Dissolved Air Flotation (DAF), Ultrafiltration (UF), Reverse Osmosis (RO), pH adjustment, Oxidation systems, Oxygenation systems + Additional equipment & chemical treatment as required.
- TES would treat the water to Client's required standards
 - Resolution 0631 (2015) for surface disposal.
 - Minimum quality & solids concentrations + particle sizes for downhole disposal.
- These technologies from our strategic supplier in the US are currently being used in North America, South America, Middle East & Australia.

Produced Water Treatment

Case Study: Produced Water



Total Environmental Solutions

Additional Water Treatment Capabilities:

- COD & BOD to <5.0 mg/L (max. permissible value: 60 mg/lt)
- Nitrogen & Phosphorous to <5.0 mg/L (max permissible value: 10 mg/lt)
- Bacteria to Non-Detect
- Others as required

Parameter	Units	0631/2015 Colombian Resolution maximum permissible limit value	Influent	EC Effluent	RO Effluent
TSS	mg/L	50	1,3	< 5.0	< 1
TDS	mg/L	N/A	680	720	< 20
FOG	mg/L	15	1,5	Non-Detect	Non-Detect
Iron, Total	mg/L	3	950	0.29	< 0.2
Turbidity	NTU	Analysis and report	> 1000	< 1.0	< 1
Sodium	mg/L	Analysis and report	200	195	< 6

Technologies to be employed by TES are currently deployed in multiple locations across North America and other continents. Designed to meet the strictest USA EPA discharge standards, the highest standards in the world.



Waste Water Treatment TES Technologies and Services

Waste Water – Grey & Black Water:

- The **Membrane Bioreactor System (MBR)** is the next generation of waste water treatment technology replacing the Conventional Activated Sludge system (CAS)
 - Developed in the US based on the years of experience of polymer science and the membrane technologies.
 - MBR system is equipped with fine-bubble air diffusers, which significantly reduces the daily cleaning operation of air diffusers and increases the oxygen dissolution efficiency.

The process flow of the CAS and MBR systems are shown in Fig.I-1 and Fig.I-2, respectively.

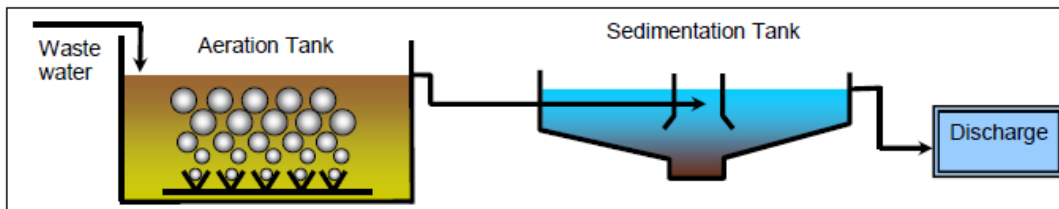


Fig. I-1 CAS Flow

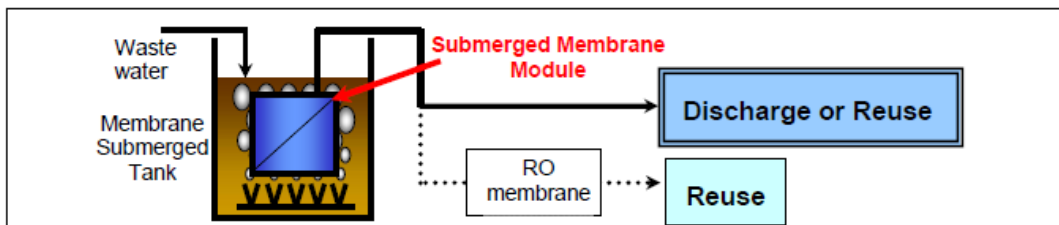


Fig. I-2 MBR Flow

Benefits of MBR over CAS

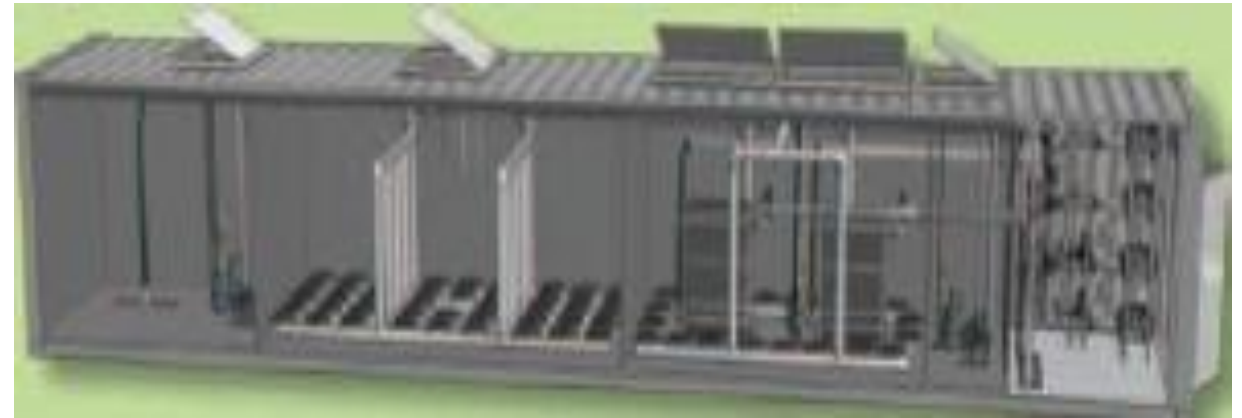
- **Smaller footprint** as sludge separated with membranes so no sludge tank required
- **Higher quality of treated water** as MBR removes suspended solids (SS) from the sludge liquid with membrane, which is much more effective than CAS
- **MBR efficiently rejects microorganisms** such as *Escherichia coli* and *Cryptosporidium*.

Waste Water Treatment

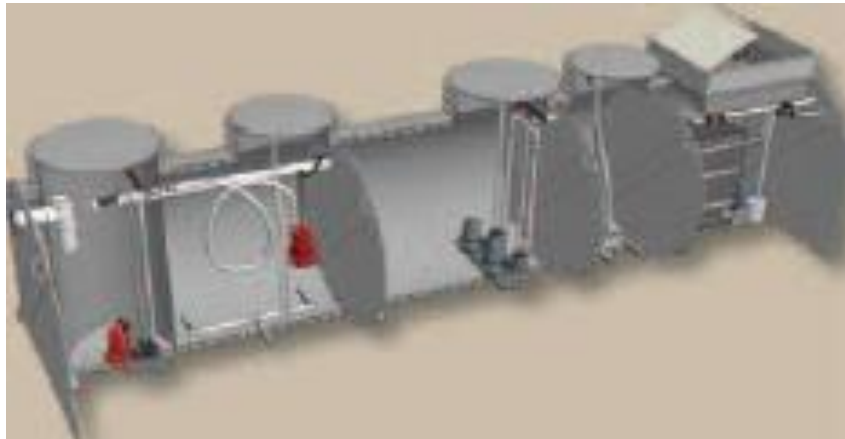
Domestic Sewage Treatment

DELTA

- An innovative and sustainable line of wastewater treatment systems.
- Designed for residential, commercial, industrial, agricultural, institutional, mining, municipal and human wastewater applications.
- All systems are custom engineered and manufactured to match specific project requirements reflective of distinct influent wastewater strengths, effluent discharge limits, site constraints and unique regulatory requirements.
- These systems use best in class **MBR modules** to treat the effluent in addition to aerobic reactors to digest the biological material to leave the lowest volume of sludge to be land applied or land filled.
- Pre fabricated, pre tested, fast setup then “plug and play”.



Waste Water Treatment Plants above ground or below ground



Waste Water Treatment Expertise and Experience



Clark Hicks - Technical Director, project highlights

As the owner of ND Waste Water Treatment, Mr. Hicks has many design-build treatment plants situated in The Bakken oil fields. Applications include man camps, residential planned communities, hotels, industrial treatment plants and produced water. Some of these projects also included potable water treatment and delivery including fire suppression delivery. Many plants meet or exceed the EPA's strictest standards for surface discharge.

As the National Sales Manager for App-Tech Solutions, treatment plants were engineered and installed for large school districts, small municipalities, hospitals, wineries, industrial processes, mining waste ponds, US Department of Defense Rapid Deployment, US State Department embassy locations.

As the owner of Fury Brothers LTD, Mr. Hicks did design, build and operate many treatment plants that specialized in treating contaminated seawater for human consumption. Those areas were Belize, The Bahamas and the United Arab Emirates.

In addition Mr. Hicks is a US General Contractor of 25 years experience working in utilities, vertical multistory, Federal and State Government contracts, municipalities and Tribal Nations.

Waste Water Treatment

Case History: Project Highlights



North Dakota Tertiary Waste Water Treatment Plant

- 40,000 gpd (9500 bpd) of treated water.
- Design, Build, Installation and Commission.
- Permitted and approved by the EPA, Corp of Engineers, State of North Dakota, Three Tribes Nation and City of Bismarck.
- Effluent discharge tested at COD < 5 ppm, TDS < 5 ppm, TSS < 5 ppm, E-Coli non detect.
- Direct discharge to Missouri River.
- Gentlemen in picture are installation crew and Technical Director (far right).

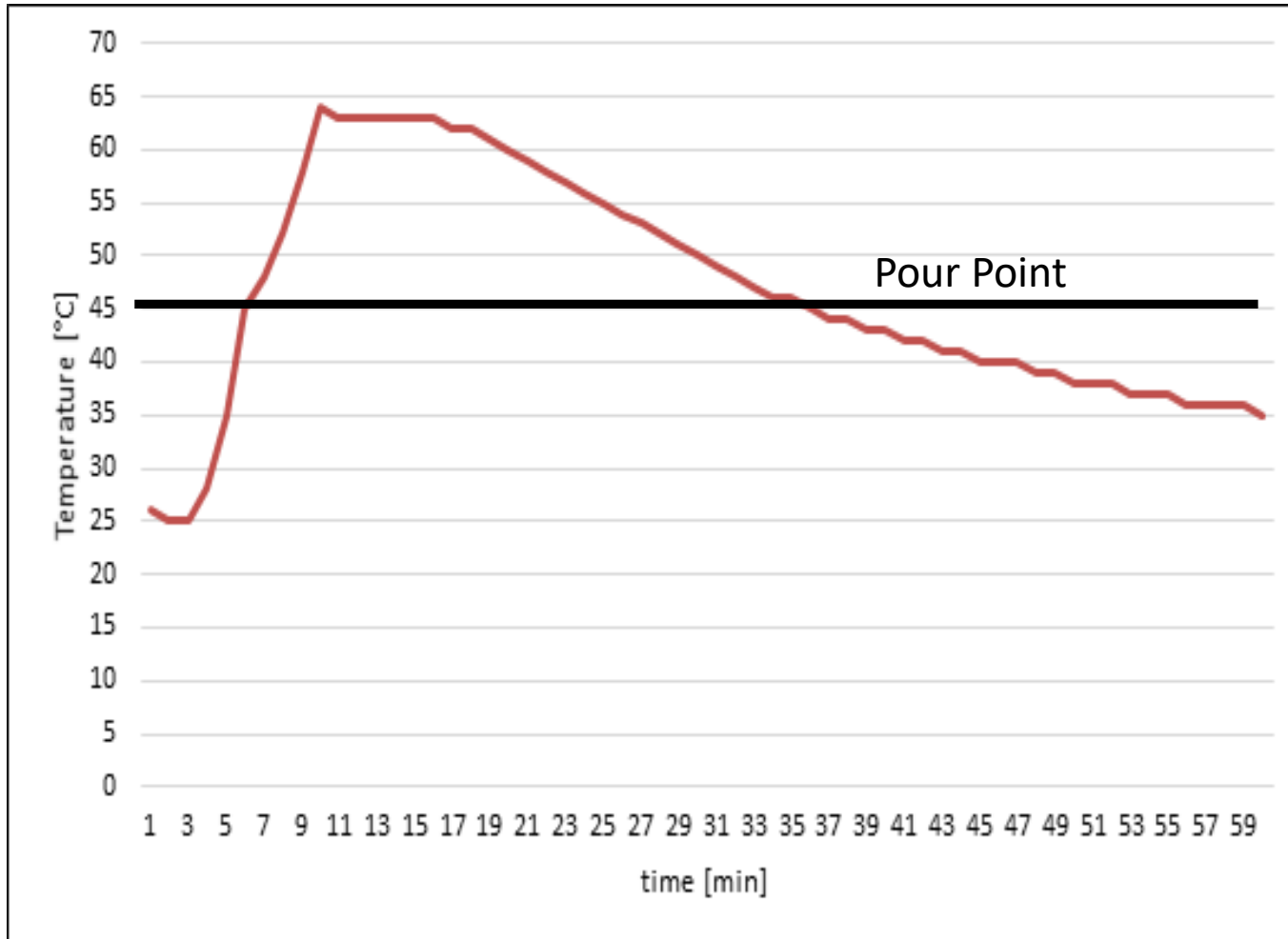


TES Technology Application: Crude Oil Heating (Exothermic Additive)

- Heavy oils require mechanical heat, naphtha or condensate to reduce viscosity to their pour points to enable them to be offloaded from a crude oil tanker truck.
 - High cost
 - Lengthy process
- TES' organic exothermic heating additive can be effective in replacing the above methods.
- Field trial + lab testing demonstrations made in Colombia for a major oil pipeline transportation company.
 - Thermal additives reduced heavy oil tanker offloading times from 4 hours to 30 minutes, so increasing station throughput
 - **No changes made to the oil's physical or chemical characteristics**



TES Technology Application: Crude Oil Heating (Exothermic Additive)



Crude oil heating profile (exothermic organic additive)

The importance of this assessment is in determining how much heat must be applied to raise the temperature of the 15° API oil above its 'pour point' to enable fast offloading.

Conclusion: It takes less than 7 minutes for this specific oil to heat to the oil desired temperature and it will stay above the pour point for 30 minutes in a laboratory environment.

TES experience shows that in the real-world environment these lab results should be multiplied by a 4 for the heating process and a factor of 5 for the cooling process considering the laws of thermodynamics and the thermal convection currents will be created during the heating process.

The ratio of cooling down depends also depends on the Ambient temperature, Container it is in, Exposure to moving air, Viscosity curve.

We can thus conclude that each truck should have around 30 minutes to heat up sufficiently and the oil would remain at a temperature for more than 2 hours based on the viscosity curve vs. heating profile.

Conclusions

- **TES services are customised** to each clients needs and follow a methodical & orderly implementation process.
 - Lab testing, Customised equipment & process design, Best-In-Class service providers in the US & Colombia, Continuous improvement during operations
- **TES operates on a service basis** and provides and pays for all of the required equipment, additives and service personnel, **and all ongoing operational & maintenance support.**
 - The client risk is minimised by paying a volume based treatment fee to TES.
- **TES can provide key service offerings with its fixed or mobile units** that offer substantial benefits to the client, such as:
 - Waste Oil Recovery from emulsions on-site removing need to ship to third party facilities
 - Produced Water & Waste Water (grey & black) Treatment to client specifications, including desalination, using proven & globally-mobilised technologies & processes from the US
 - Soils & Solids Remediation as required using proven technologies & methods
 - Heavy Crude Oil Tanker Truck Offloading, assisted by TES' organic exothermic heat additive
- **Client can realise significant financial benefits** from TES' **oil recovery** from waste oil recovery services.
 - These services can be implemented within 6-8 weeks of signing a contract.