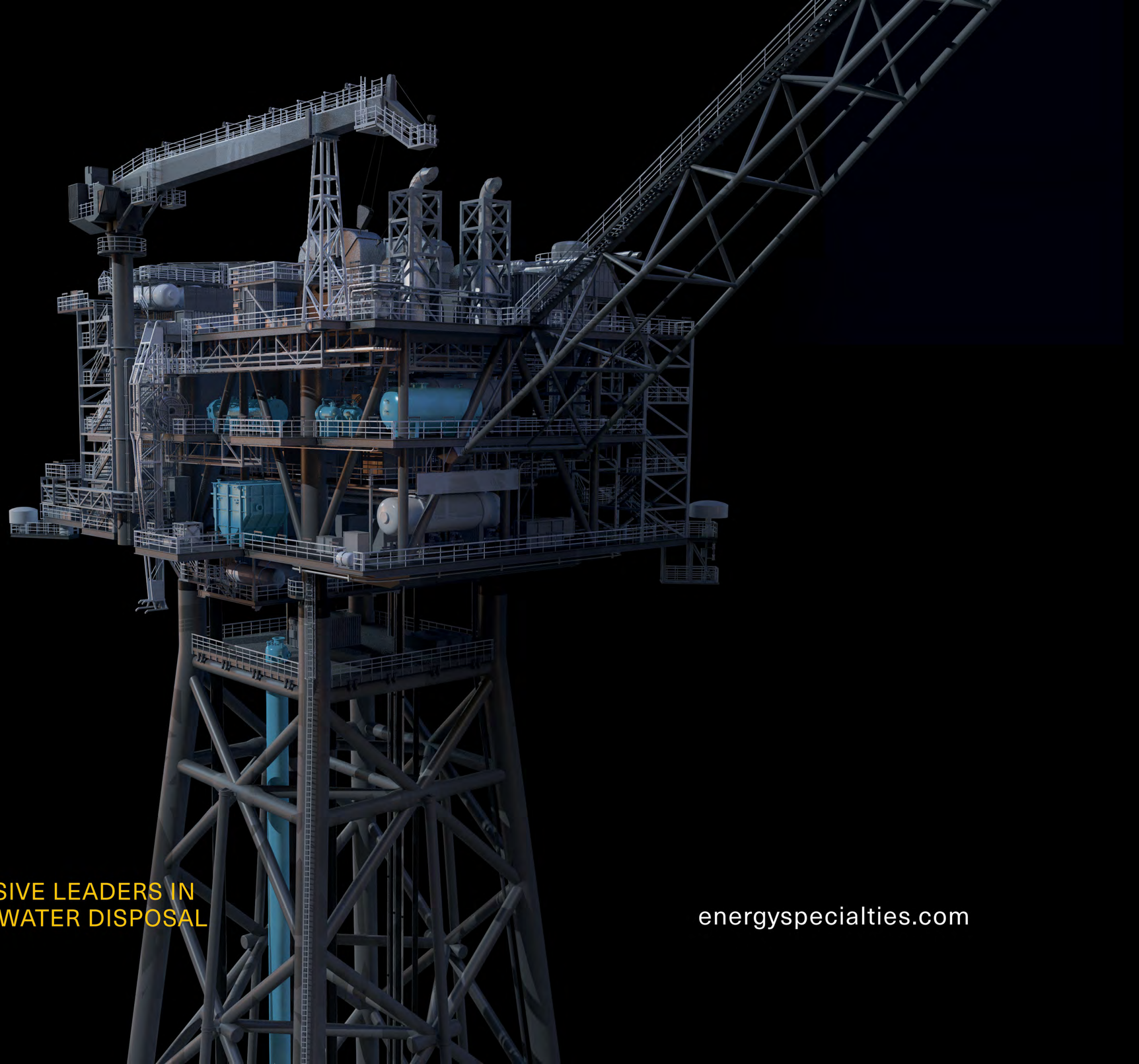


ENERGY SPECIALTIES INTERNATIONAL

A GLOBAL WASTEWATER SOLUTIONS COMPANY | EXCLUSIVE LEADERS IN WASTEWATER DISPOSAL

energyspecialties.com

WATER TREATMENT

ESI guarantees all equipment and system packages' performance. So when you need a Produced Water Conditioning System, Wastewater Treatment equipment or have a difficult separation problem, turn to the experts...ESI.

1 | INLET SKIMMER

These units are designed to provide large residence times during which coalescence and gravity separation can occur.

2 | HYDROCYCLONE - SPIRAL RAMP LQ-R®

Improves efficiency by providing a long entry conduit, wrapping it around the hydrocyclone, so the feed enters via a spiral-ramped path.

3 | IGF - QUADAIR®

A four-cell flotation system designed to float out emulsified oils and suspended solids by inducing gas bubbles.

4 | CPI - ADF®

45° Down-flow Parallel Plate Separator designed and sized to remove oil and sand from wastewater.

5 | DRAIN CAISSON - SKIM PILE®

An internally plated vertical drain caisson designed to remove free oil (>50 µ) from Open and Closed Drains.

OUR PROCESS

ENERGY SPECIALTIES INTERNATIONAL

Energy Specialties International (ESI) is a Texas corporation engaged in the sales, engineering, design, manufacturing, installation and technical servicing of Produced Water & Wastewater Treatment Equipment. ESI has spent years improving traditional equipment such as our Skim Pile® Drain Caisson, Quadair® Induced Gas Flotation Unit (IGF), and ADF Corrugated Plate Interceptors (CPI) while continuing to develop new products such as the patented Spiral Ramp LQ-R ® Hydrocyclones and Vertifloat® Compact Flotation Unit (CFU).

Because disposal of offshore wastewater directly impacts the environment and disposal limits continue to become more stringent, it is vital for engineers and operators to understand the factors that determine the effluent quality of various equipment. Knowing when and why to use a particular separator or drain caisson for a specific application can be challenging. This brochure focuses solely on our offshore wastewater disposal technology to assist you in making an informed decision.

THE EQUIPMENT HIGHLIGHTED IN THIS BROCHURE IS:

SKIM PILE®: DRAIN CAISSON

A vertical caisson integrated in the jacket structure or hull. It incorporates patented baffles and oil risers and is designed to remove free oil (>50µ) from Open and Closed Drains.

HYDRO PILE® CAISSON

A vertical caisson integrated in the jacket structure or hull. It incorporates half baffles without the use of oil risers and is designed to remove free oil (>500µ) from Open and Closed Drains.

DISPOSAL CAISSON

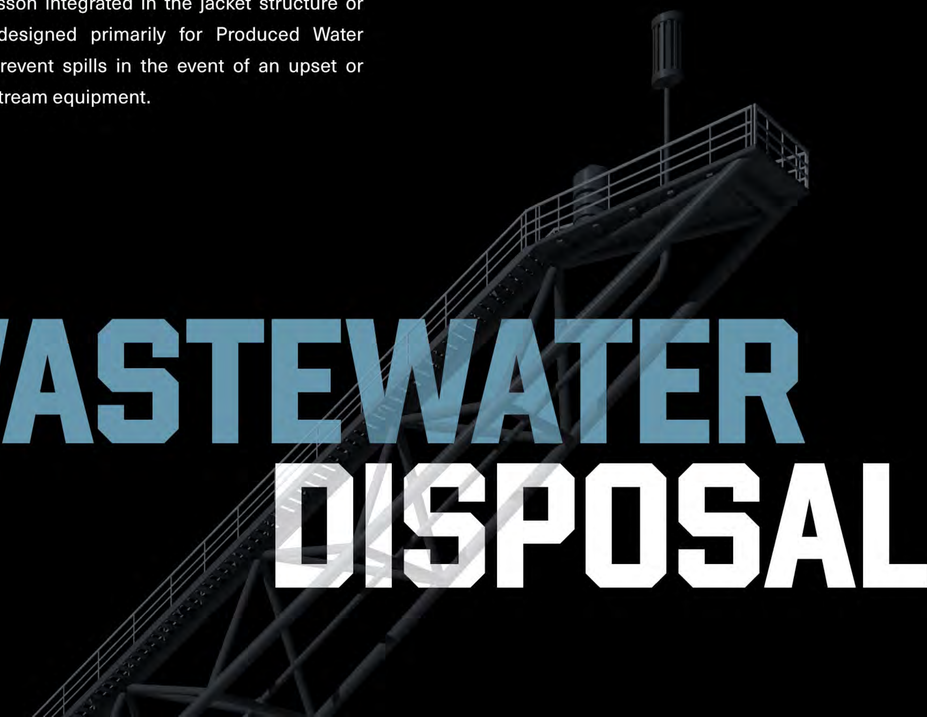
A vertical caisson integrated in the jacket structure or hull and is designed primarily for Produced Water Disposal to prevent spills in the event of an upset or bypass of upstream equipment.

ADF CPI: DOWNFLOW PLATE SEPARATOR

An atmospheric or pressurized vessel located on a platform's lower level. This vessel contains a series of baffles and corrugated plates at 45° and is designed to remove specific quantities of oil from wastewater.

AUF CPI: UPFLOW PLATE SEPARATOR

An atmospheric or pressurized vessel located on a platform's lower level. This vessel contains a series of baffles and corrugated plates at 60° and is designed to remove specific quantities of oil and sand from wastewater.



WASTEWATER DISPOSAL

"No discharge of free oil means that waste streams may not be discharged that contain free oil as evidenced by the monitoring method specified for that particular stream, e.g., deck drainage or miscellaneous discharges cannot be discharged when they would cause a film or sheen upon or discoloration of the surface of the receiving water."

ESI WASTEWATER DISPOSAL EQUIPMENT:

- Prevents polluting oceans & seas
- Prevents violating EPA 40 CFR 435
- Prevents costly fines and shut-in
- Reduces OpEx
- Requires minimal maintenance

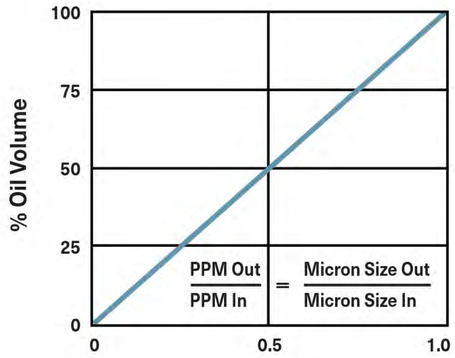
NOTE: In warmer climates during calm seas, surface drains can sheen with as little as 5ppm of oil present. This is mitigated with sub-surface disposal by means of an ESI Caisson.

EPA 40 CFR 435.11.X

DESIGN CONDITIONS TO CONSIDER

INLET & EFFLUENT PPM/ MICRON CONCENTRATION

The relationship between oil droplet size and oil concentration is essential in determining the effectiveness of an oil/water separator. You must calculate the micron size to be removed to achieve your required effluent.



"It is clear there will be a distribution of droplet sizes from zero to the maximum size, and this distribution will depend upon parameters unknown at the time of initial design. Experimental data indicates that a conservative assumption for design would be to characterize the distribution in this manner."

(Arnold K., Stewart M. Surface Production Operation)

Oil with a high specific gravity and not finely dispersed in the water nor entrained in the water as large droplets will be more likely to cause a sheen. It is also safe to assume that, due to the use of soaps and detergents in deck wash down, much of this "free oil" will be less than 150µ in size.

(Arnold K., Steward M. Designing Oil and Gas Production Systems. World Oil)

REYNOLDS' NUMBER & STOKES' LAW

For oil/water separation to occur using Stokes' Law and the Reynolds' Number, there must be laminar flow. These equations determine the exit and rising velocities of water and oil in a caisson.

Stokes' Law calculates the rate of rise/fall of particles in water, whereas the Reynolds' Number is the ratio of inertial forces to viscous forces within a fluid. Oil/water characteristics such as specific gravity, temperature, and viscosity, along with flow rate and particle size, are used to compute the performance of drain systems.

In all drain systems, the rising velocity of the oil must be greater than the exit velocity of the water for separation to occur. Due to the extremely high Reynolds' Number during the flow period through a drain caisson, little or no oil separation will occur. In fact, there is a strong possibility that remixing of separated oil that is not protected from the incoming flow will take place.

Stokes' Law: $V_o = \frac{1.78 \times 10^{-6}(\Delta SG)dm^2}{U_w}$

V_o = Vertical velocity of the oil droplet relative to water ft./sec.

ΔSG = Difference in specific gravity of oil and water

dm = Diameter of oil droplet, micron

U_w = Viscosity of the water, CP

Reynolds' Number: $\frac{Dvp}{\mu e}$

D = I.D. of pipe in ft.

v = Mean velocity of flow, ft./sec.

p = S.G. of fluid, lbs./ft^3

µe= Absolute viscosity, lb. mass/ft. sec.^{2}

CORROSION PROTECTION

Per DNV-RP-B401, 5.8.1, "The use of non-metallic coatings drastically reduces the CP current demand of the protection object and hence, the required anode weight. For weight-sensitive structures with a long design life, the combination of a coating and CP is likely to give the most cost-effective corrosion control. For some systems with very long design lives, CP may be impractical unless combined with coatings. "

ESI can coat the baffled section in highly corrosive applications.

FLOW RATE

When determining flow rate, critical elements include produced water flow, deck surface area, wash down water, and open/closed drain water with the respective inlet oil concentrations. Since drain caissons are designed for intermittent flows, the worst case for operation is used as the basis for design.

RETENTION TIME

Drain systems should be designed for a 20 minute retention time (industry standard). This amount of time is adequate to prevent spills and allows for removal of oil particles down to 50µ.

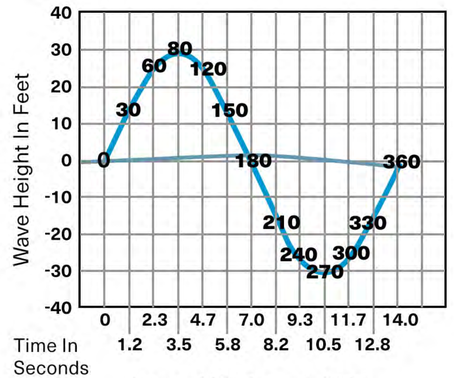
WATER DEPTH

In shallow water (≤15m), CPI vessels or closed-end drain caissons are required to attain the needed retention time and baffle plated length. In deep water (≥30m), open-end drain caissons are preferred since they can handle larger volumes. Water depth is critical in calculating the plated length of a caisson.


Corrosion Protection

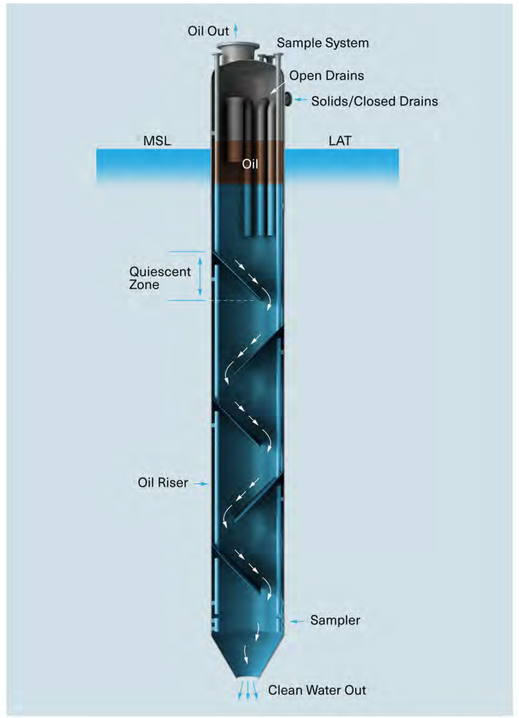
INTERNAL MOTION

The motion of the oil/water inside a drain caisson is a factor of the inlet flow rate, quantity of baffles, spacing, cut out size of the baffle plates, along with the external wave height and period. Low internal motion is vital so that oil can be removed using level controls with pumps or a Blowcase. Turbulence within the caisson will reduce the efficiency.



Internal Motion = 1.19 Ft.

SKIM PILE®
(DRAIN CAISSON WITH OIL RISERS)



ESI's Skim Pile® treats deck drains for strictly regulated applications with an intermittent flow utilizing multiple baffles, oil risers, and separating oil from water and sand. This equipment can also be a final discharge point for pre-treated produced water and is designed to contain any upstream upsets preventing unnecessary discharge violations.

Oil/water separation and sand cleaning occurs as intermittent rain and wash down water flows through a series of baffle plates. The tight spacing of the baffle plates create quiescent zones which reduce the distance a given oil droplet must rise to be separated from the main flow. Once in the quiescent zone, there is sufficient time for coalescence of the oil particles. The ever-growing droplets then migrate up the underside of the baffle into the oil riser. The risers prevent the oil droplets from being swept back into the turbulent flow stream and remixing with the incoming water.

Additional oil/water separation is achieved through coalescence because of the large number of baffle plates, long retention time and low energy output of the Skim Pile®. Free oil is removed from sand due to the agitation and abrasion created as the sand tumbles down the series of baffle plates and is disposed of through the end of the caisson.

The Skim Pile® is the final stage of the open drain and/or produced water treatment system and is guaranteed to remove all oil globules >50 microns.

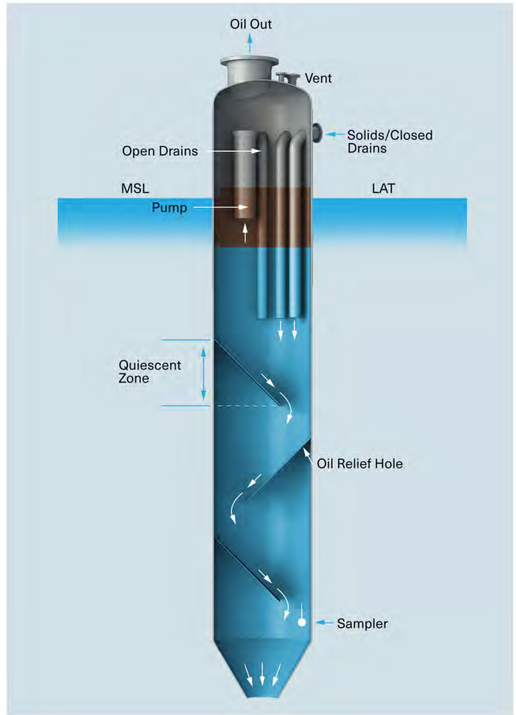
A Skim Pile should be the preferred caisson for applications where strict adherence to regulations is of concern.

To view a short video on how the Skim Pile works, please use this QR Code

HYDRO PILE®
(PLATED CAISSON)

Separation of oil, water and produced solids occurs if rain, wash down or produced water flows through a series of baffle plates, which extend to the center of the caisson. The baffle plates are spaced ten feet apart and form quiescent zones for the oil to coalesce and rise through the oil relief hole. The coalesced oil particles must then be large enough to overcome the exit velocity created by the inlet flow. Oil particles with a rate of rise less than the exit velocity of the incoming flow will be remixed with the inlet flow resulting in effluent concentrations ranging from 65 PPM to 400 PPM.

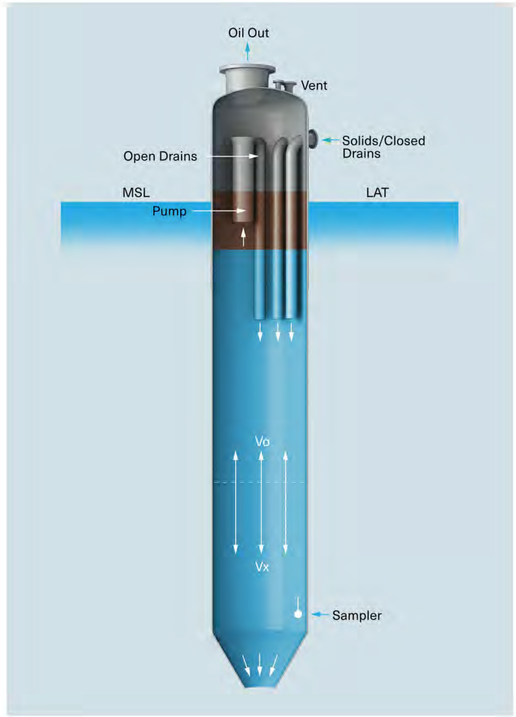
A Hydro Pile is ideal for applications where there is continuous flow and have minimal discharge regulations.



DISPOSAL CAISSON
(UN-PLATED CAISSON)

The unplated Drain caisson is a vertical oil/water separator. Length in excess of 10 feet does not increase the oil removing efficiency of the device; however, increasing the length does increase the retention time. The only method of improving the removal efficiency of this type of separator is to increase the inside diameter of the caisson which reduces the exit velocity of the incoming flow, allowing smaller oil particles with low rising velocities to ascend.

This type of design is primarily used for disposal of pre-treated produced water and for containment of upstream upset or bypass conditions.



SKIM PILE® SHELL MATERIAL OPTIONS

2507 Super Duplex Stainless Steel

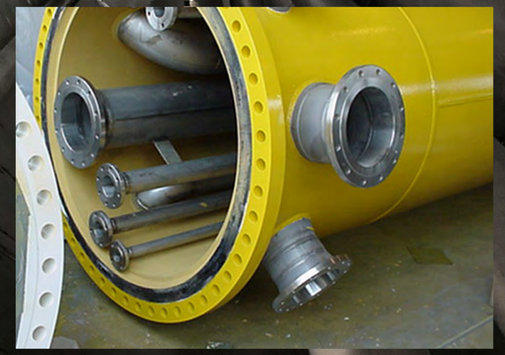
316 Stainless Steel

Carbon Steel

SKIM PILE® INTERNAL MATERIAL OPTIONS

2507 Super Duplex Stainless Steel

Carbon Steel



316 Stainless Steel

Fiberbond / GRP

Monel

DRAIN CAISSON OIL REMOVAL SYSTEM

Oil Removal Systems	Description	Maintenance
Blowcase	A small pressure vessel located in the oil pad of the Drain Caisson. Instrumentation package included to automatically control on/off.	Low/No
Air-Operated Double-Diaphragm (AODD) Pump	Pump can be installed inside the Drain Caisson above the oil pad for minimal exposure to the elements and little to no maintenance required.	Low/No
Submersible Electric Pump	Pump mounted from the top of Drain Caisson to a calculated elevation submerged in the oil pad. Most expensive option with highest maintenance required.	Mid/High

Drain Caisson Sample System Head Assembly

DRAIN CAISSON SAMPLE SYSTEM

ESI Sample System Options	Description
ESI Standard Sample System	The Standard Sample System includes CuNi stick tubing, 316SS coil tubing, a 316SS Sample Head Assembly and a bronze check valve. This system has been used by ESI for 35+ years in Drain Caissons around the world. It is proven technology for most Drain Caisson applications.
Super Duplex Stainless Steel Sample System (SDSS)	The SDSS Sample System includes 2507 SDSS stick tubing, Inconel 625 coil tubing, an SDSS Sample Head Assembly, and an ESI proprietary SDSS check valve. This sample system is designed for extended service life (50+ year) installations.

DRAIN CAISSON PHOTOS

CORRUGATED PLATE INTERCEPTOR (CPI)

The ESI CPI is designed and engineered for oil recovery applications where energy usage and equipment costs are a determining factor. The CPI is a gravity separator where efficiency is determined by the rising velocity of the smallest particles that will be intercepted, usually greater than 50 microns. Using Stokes' Law, the rate of rise of the oil can be calculated. The greatest advantage of the ESI CPI is that the rising distance is usually less than 25mm. This allows the oil droplets to rise and coalesce to larger droplets while allowing sand to fall out of the flowing stream.

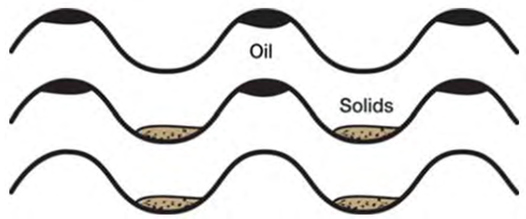
ESI offers Upflow and Downflow CPI options depending on the application. An advantage of the Upflow CPI configuration is that it can be fitted with a sand cleaner which uses high-pressure water to blast oil-wet sand particles into a hopper where the oil is knocked loose from the sand.

SOME ADVANTAGES OF AN ESI CPI INCLUDE:

- No power requirement
- No moving parts
- Compact design/min. footprint required
- Low initial cost
- Low operating cost
- Low maintenance cost

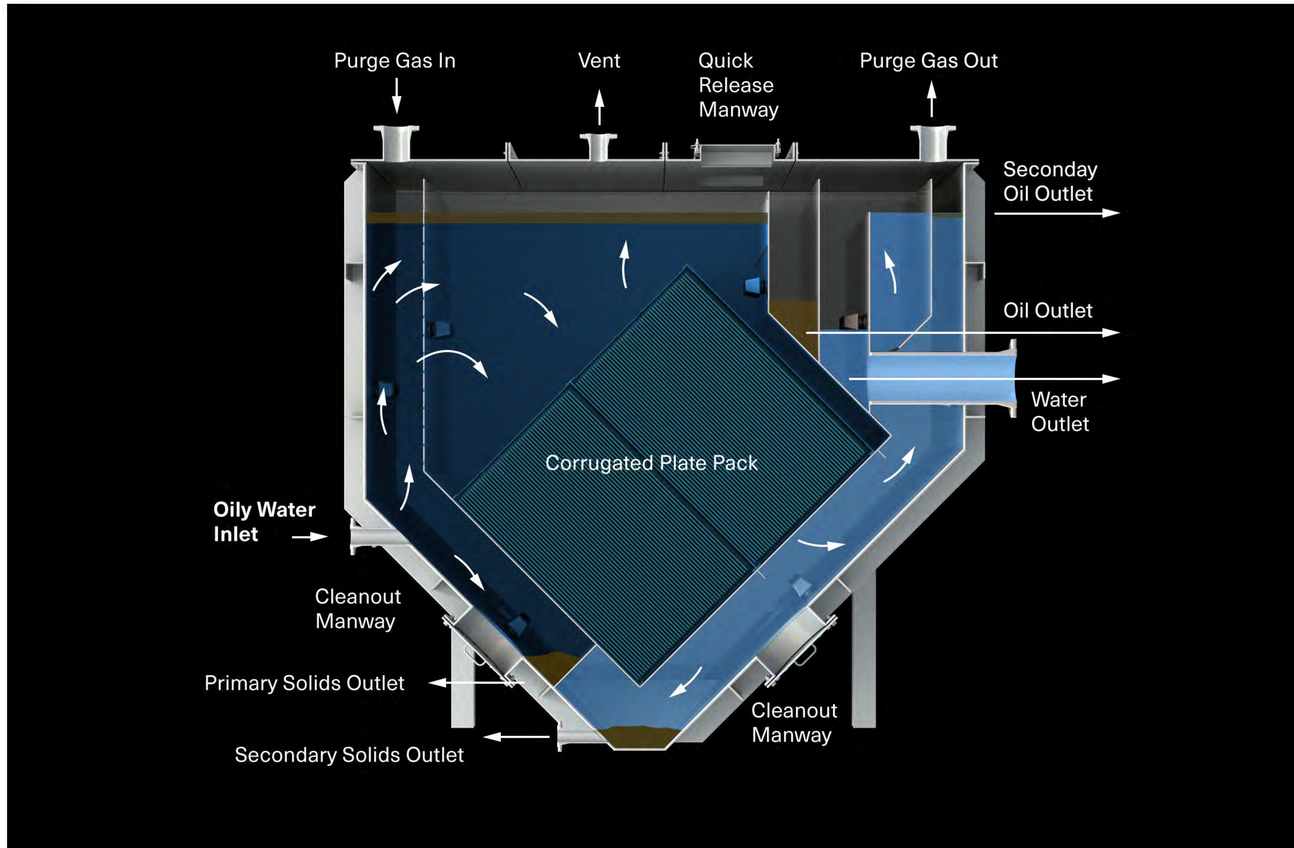
To get more information on ESI's CPI, please use this QR Code

The plate pack is made of many closely spaced corrugated plates. These packs can be manufactured in fiberglass or stainless steel, depending on the application requirements.



ESI CPI Selection Chart (based on 90% Removal Efficiency @ 80°F)

Model No.	Flowrate (BWPD)	No. of Packs	Approximate Size (L x W x H)	Approximate Dry Weight	Approximate Operating Weight
ADF-0.5	3,000	1/2	9'-0" x 5'-0" x 9'-0"	5,000	13,000
ADF-1	5,000	1	10'-0" x 5'-0" x 10'-0"	7,000	16,000
ADF-2V	10,000	2	14'-0" x 5'-0" x 14'-0"	14,000	32,000
ADF-2H	10,000	2	10'-0" x 8'-0" x 10'-0"	14,000	32,000
ADF-4	20,000	4	14'-0" x 8'-0" x 14'-0"	24,000	70,000
ADF-6	30,000	6	14'-0" x 12'-0" x 14'-0"	32,000	100,000
ADF-8	40,000	8	14'-0" x 16'-0" x 14'-0"	40,000	130,000
ADF-10	50,000	10	14'-0" x 20'-0" x 14'-0"	48,000	160,000
ADF-12	60,000	12	14'-0" x 24'-0" x 14'-0"	56,000	200,000



CPI PHOTOS

FACILITIES & CAPABILITIES

ESI's R&D facility is located in Houston, TX USA. In addition to testing new equipment and technologies, this facility is utilized as a staging and crating area for kits, pumps, sample systems, and instrumentation packages.

Along with ESI's fabricator in Vietnam, ESI has partnerships in Oman, United Arab Emirates, India, and South Korea. ESI's vast network provides customers with expediting and logistical options for every project.

Since 2005, ESI continues to have a strong partnership with a Vietnam fabricator. Their capabilities include heavy fabrication in covered and open fabrication areas totaling 142,000 m2. These facilities include in-house coating and 400m of water front property. Ocean freight is available with a 150m long jetty able to handle up to 10,000 tons.

ISO 9001, 14001 and 18001 are all followed for a complete Quality Management System covering all aspects of the project.

ESI's vast network provides customers with expediting and logistical options for every project.

CONTACT US

Want more information? Call or Email us today! We will be happy to discuss all of your wastewater needs. View the checklist below to see some of the information you should consider when contacting us:

Skim Pile Information

- Deck Area
- Water Depth
- Rainfall Intensity
- Cellar Deck EL
- Boat Deck EL
- Continuous or Intermittent Flow
- Oil Droplet Size In (Micron)
- Inlet Quality (ppm)
- Effluent Quality (ppm)

Produced Water Information

- Flowrate (bwpd)
- Temperature: Operating
- Temperature: Design
- Oil Droplet Size (Micron)
- Pressure: Operating
- Pressure: Design
- Oil Viscocity
- Water (SG)
- Oil (SG)
- Inlet Quality (ppm)
- Desired Effluent Quality (ppm)

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Use this QR Code to fill out our online RFQ form.