Oil Water Separators

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PASSION FOR CHEMISTRY

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Introduction

- Hydrocarbons (fuel, gasoline, lube oil etc.) are very dangerous for the environment and public health. They can build up explosive mixtures in piping, they can prejudice the functionality of public water treatment plants, they can pollute rivers, soils, and groundwater. For this reason they cannot be discharged directly in the public sewer or in surface waters.

- Oil separators are installed on drainage systems to protect receiving waters from pollution by oil and silt, which may be present due to minor leaks from vehicles and plant, from accidental spillage.

Area of Concern

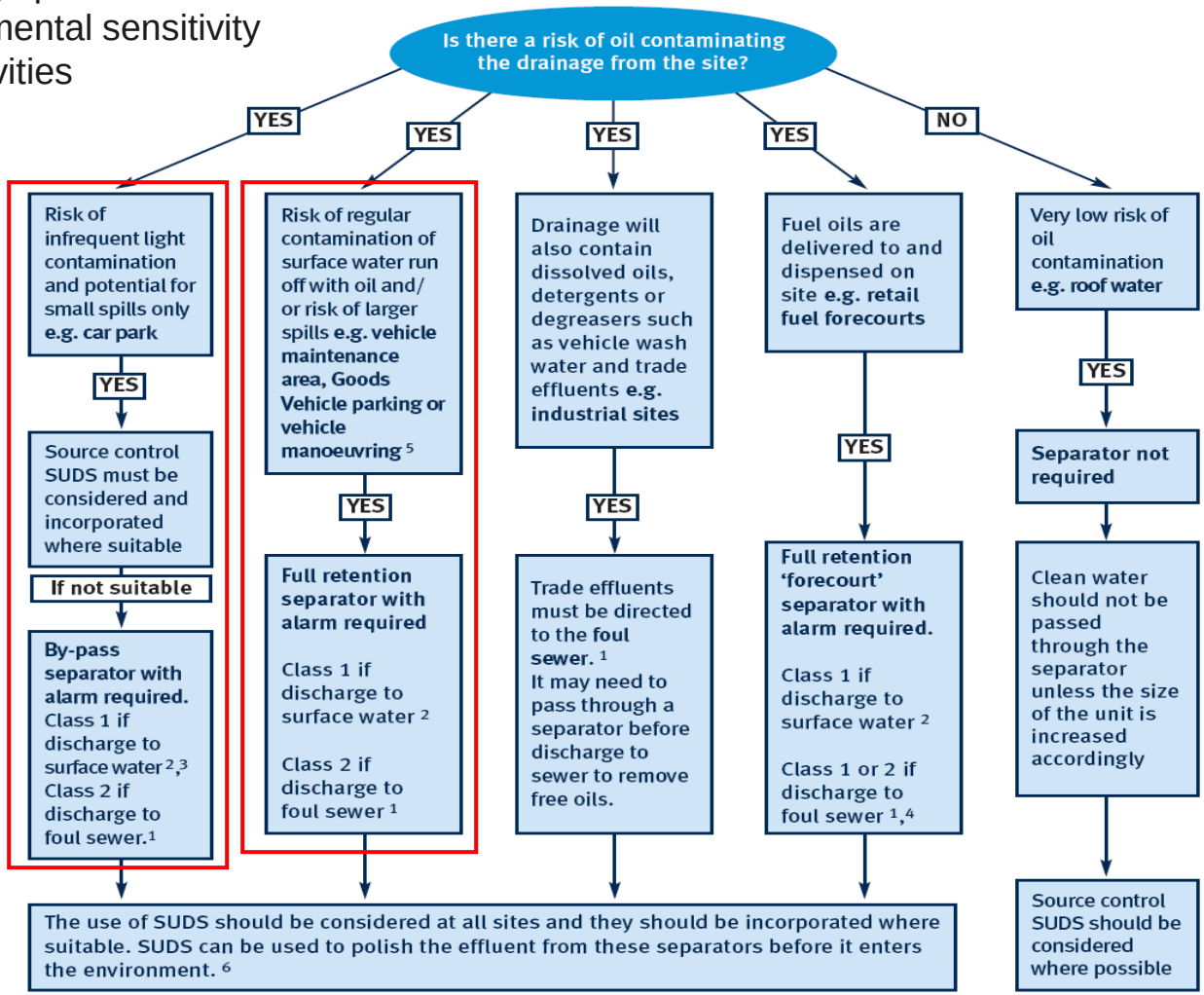
Oily Contaminated Rainwater	Oily Drains
• Transformer Area • Fuel Oil Bunded Area • Gas Compressor Compound Area • Fuel Oil Unloading Area • Car Park • Lay-down Area	• Turbine Hall • Fire Fighting Pump House • Fuel Oil Treatment Drain • Workshop Area • Fuel Oil Unloading Area

Regulations and Standards

- In the UK, the Environment Agency's **PPG3** guidelines "*Use and design of oil separators in surface water drainage systems*" are issued to enable you to comply fully with the relevant current legislation on environmental protection.
- A British (and European) standard (**BS EN 858-1** and **858-2**) for the design and use of prefabricated oil separators has been adopted. New prefabricated separators should comply with the standard.
- In the USA, *EPA Spill Prevention, Control, and Countermeasure (SPCC), Clean Water Act (CWA)* rules may apply. Design rule: API Publication 421

Selection Guide of Oil Separator as per PPG3

- Criteria
  - Discharge point
  - Environmental sensitivity
  - Site activities



Separator Classes

- The EN standard refers to two ‘classes’ of separator, based on performance under standard test conditions.

  - **Class I**
    - Designed to achieve a concentration of less than **5mg/l** of oil under standard test conditions, should be used when the separator is required to remove very small oil droplets for discharges to surface water drains and the water environment.
  - **Class II**
    - Designed to achieve a concentration of less than **100mg/l** oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies (for example where the effluent passes to foul sewer).

Type of Separator

- Full Retention Separators
- Bypass Separators
- Forecourt Separators (For Gas Stations)

- The most used separators in waste water system are:
  - Full Retention Separators
  - Bypass Separators

Full Retention Separator

- Full retention separators treat the full flow that can be delivered by the drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr. On large sites, some short term flooding may be an acceptable means of limiting the flow rate and hence the size of full retention systems.

  Application Area:

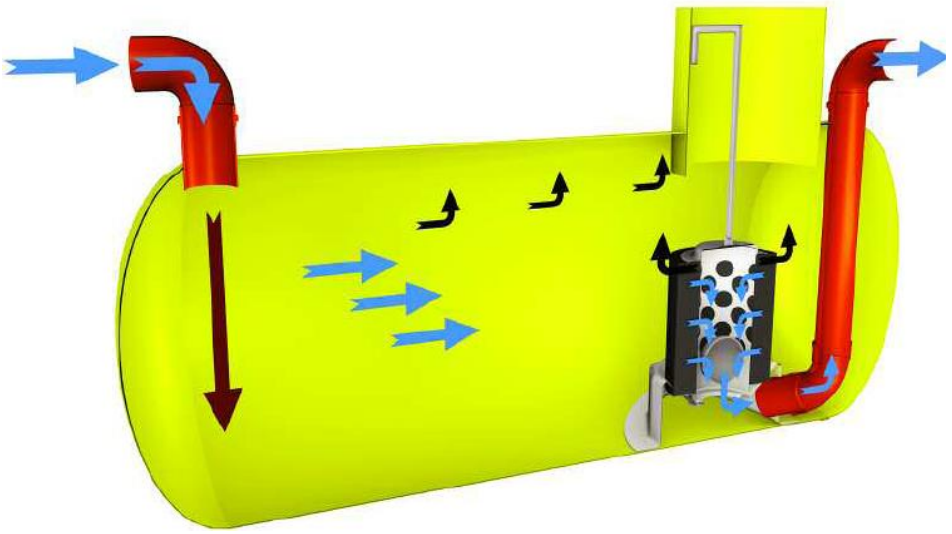
  - Sites with hi-risk of oil contamination
  - Vehicle maintenance areas/workshops
  - Fuel storage depots
  - Refuelling facilities
  - Petrol Forecourts

KEY

BROWN = Silt

BLUE = Treated flow

BLACK = Oil separation



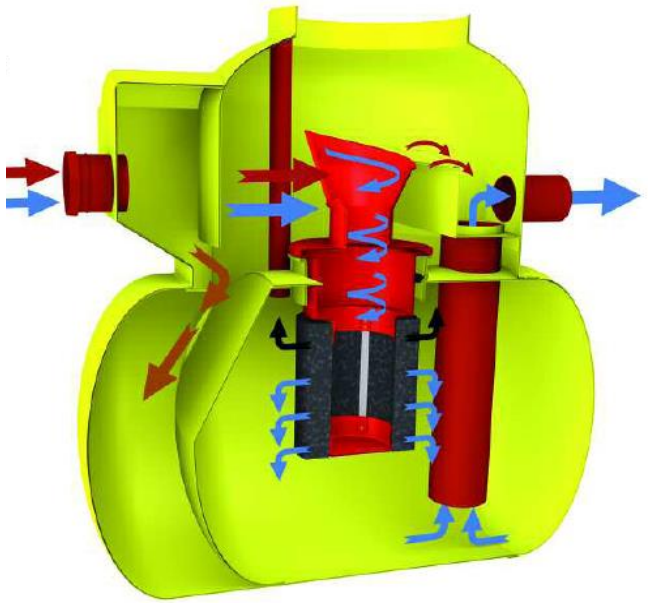
Bypass Separator

- Bypass separators are designed to treat all of the flow up to the designed nominal size. Bypass separators fully treat all flows generated by rainfall rates of up to 6.5mm/hr. These separators are used when it is considered an acceptable risk not to provide full treatment for high flows. Any flow in excess of the nominal size is allowed to bypass the separation chamber thus keeping the separated and trapped oil safe.

Application Area:

- Discharge to sensitive environment
- Roadways & major trunk roads
- Light industrial & goods yards
- Car parks

KEY
RED = Bypass flow path
BROWN = Silt
BLUE = Treated flow
BLACK = Oil separation



Forecourt Separator

- Forecourt separators are full retention separators specified to retain on site the maximum spillage likely to occur on a fuel filling station. They are required for both safety and environmental reasons and will treat spillages occurring during the vehicle refueling and road tanker delivery. The size of the separator is increased in order to retain the possible loss of the contents of one compartment of a road tanker, which may be up to 7,600 litres.
- Possible to use this for the Diesel generator/Fuel unloading station as an extra EHS precaution

Separator Size

- Each separator is allocated a nominal size (NS) on the basis of the test results.
- The nominal size of a full retention separator that is required for a catchment area (A) is obtained using the following formula:

  NS (l/s) = 0.018(*) x A (in m^2)

  *Factor derived from 65 mm/hr

- For a bypass separator, the formula is:

  NSB (l/s) = 0.0018(**) x A (in m^2)

  **Factor derived from 6.5 mm/hr

- In addition, capacity for silt storage (C) must be provided for all separators – either as an integral part of the separator or as a separate upstream unit – according to the following:

  C (in litres) = NS x 100 *or* **C (in litres) = NSB x 100**

Oil Storage Capacity (design criterion)

- The oil storage capacity is defined as the volume of separated oil that can be stored in the separator without any of the stored oil entering the inlet or outlet of the separator.

- The oil storage volume (V) is given by the following:

  - Full Retention Separator

    V (in litres) = NS x 10

    NS – Full Retention Separator Size

  - Bypass Separator

    V (in litres) = NSB x 15

    NSB – Bypass Separator Size

Silt Storage Capacity (design criterion)

- The silt storage capacity is defined as the volume of separated silt/sludge that can be stored in the separator without any of the stored silt entering the inlet or outlet of the separator.

Coalescer Filter For Gravity OWS – How it works 1

Stoke's Law

- It defines the terminal rise velocity of a given sized oil droplet.

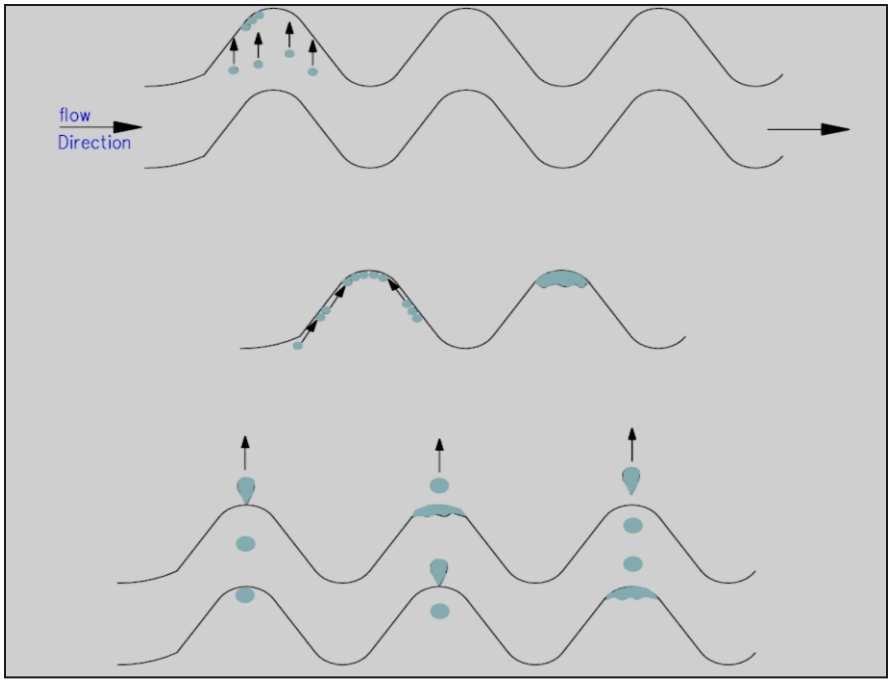
$$V_s = \frac{2}{9}\frac{(\rho_p - \rho_f)}{\mu} g\, R^2$$

Vs is the particles' settling velocity (m/s) (vertically downwards if ***ρp > ρf***, upwards if ***ρp < ρf***),
g is the gravitational acceleration (m/s^2),
μ is the fluid's viscosity (in [kg m-1 s-1]),
R is the radius of the spherical object (in m),
ρp is the mass density of the particles (kg/m^3), and ***ρf*** is the mass density of the fluid (kg/m^3).

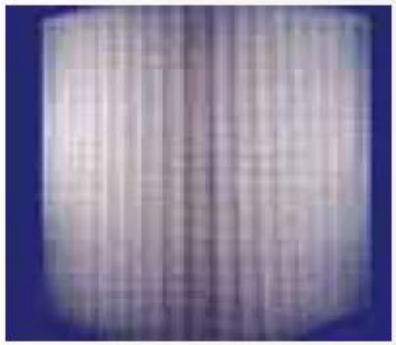
- A suitable surface for oil droplets to meet and grow, or coalesce, into larger droplets. As oil droplets grow in size the buoyancy of the droplets increases.
- Emulsified oil or very small droplets of oil can take weeks to separate

Coalescer Filter – How it works 2

- The droplets rise towards the surface of the water due to the fact that the specific gravity of oil is less than the specific gravity of water. As oil droplets coalesce into larger droplets, the buoyancy of the droplets increases. In this way the oil will form a layer that can be separated from the water by skimming action before the water is reused or discharged



Coalescer Material of Construction and Different Designs

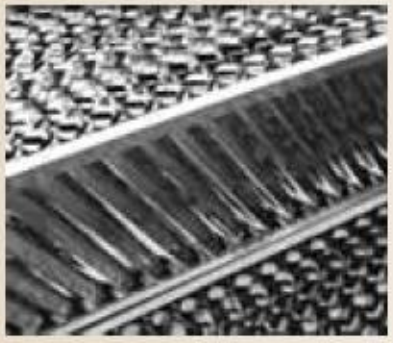


Vertical Tube
$75 per Cubic foot

Plastic Corrugated
$8.50-$11.50
per cubic foot

CPI
$241 per cubic foot

Plastic Latice
$25 per cubic foot



Stainless Steel
Corrugated
$120 per cubic foot

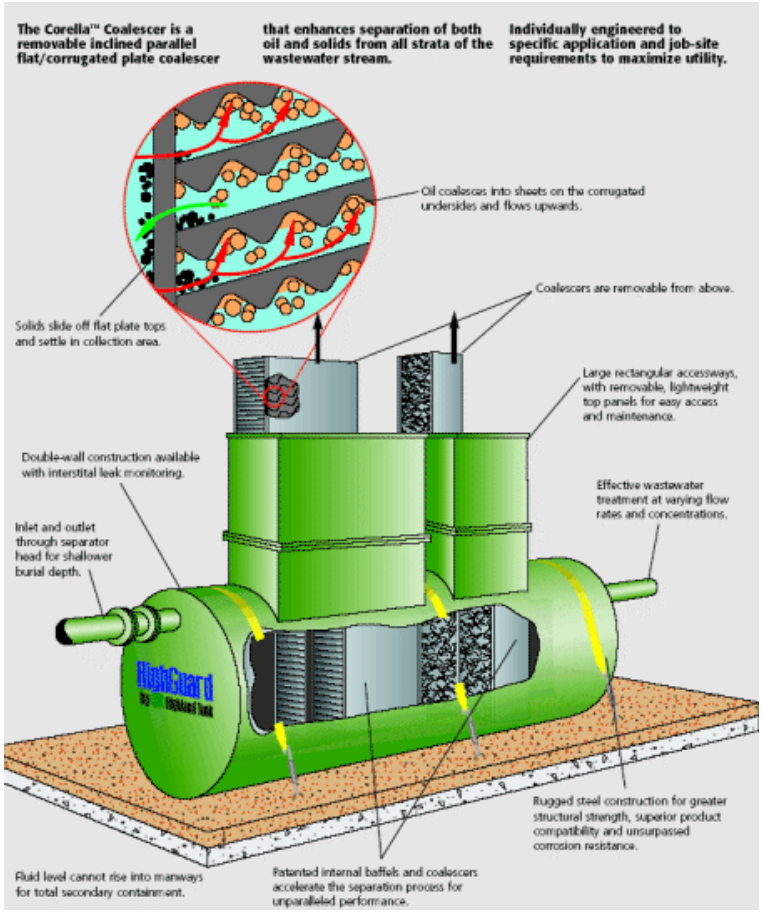
Fibrous Mesh
$120 per cubic foot

Parallel Plate Coalescer (lamella type)

Hybrid Designs

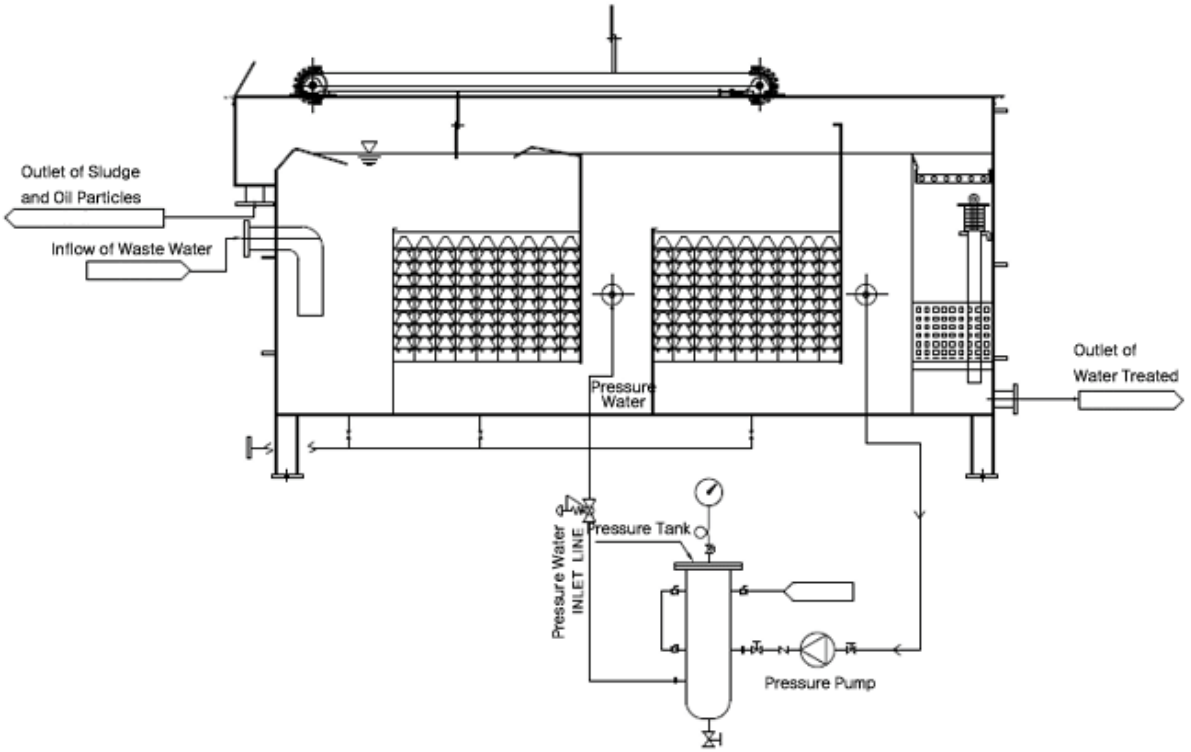
- It is possible to combine different types of coalescers:

For example, Praller Plate Coalescer for processing high-solids oily waste water followed by an Interceptor pack for polishing

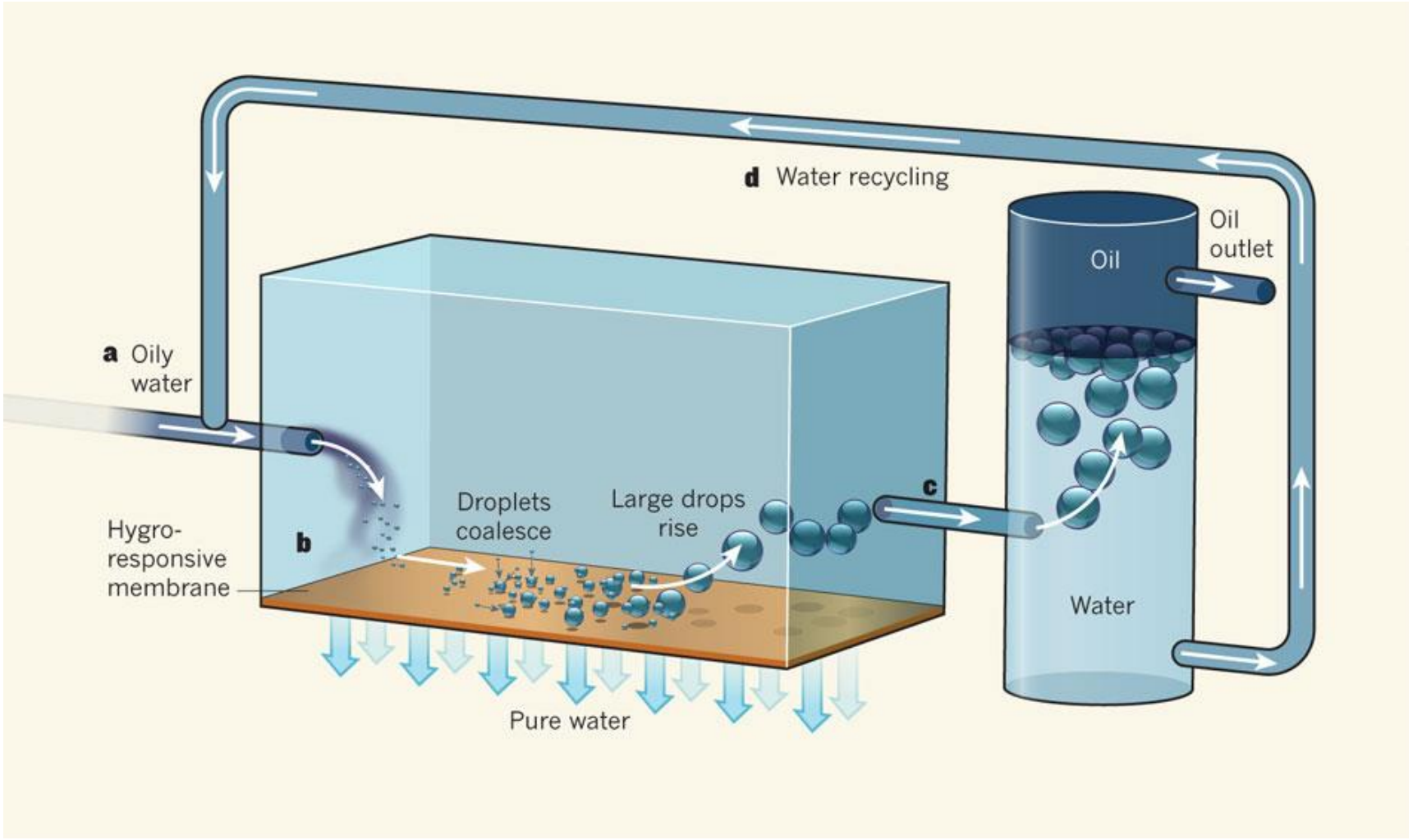


Oil Water Separators using DAF

- Another type of oil water separator uses the Dissolved Air Flotation technology (higher flow rates can be achieved)
- Usually a pretreatment for gravity oil water separators



Oil Water Separators using Membranes



ZIMPRO Process

- Wet oxidation is a form of hydrothermal treatment. It is the oxidation of dissolved or suspended components in water using oxygen as the oxidizer. It is referred to as "Wet Air Oxidation" (WAO) when air is used. The oxidation reactions occur in superheated water at a temperature above the normal boiling point of water (100° C), but below the critical point (374° C).

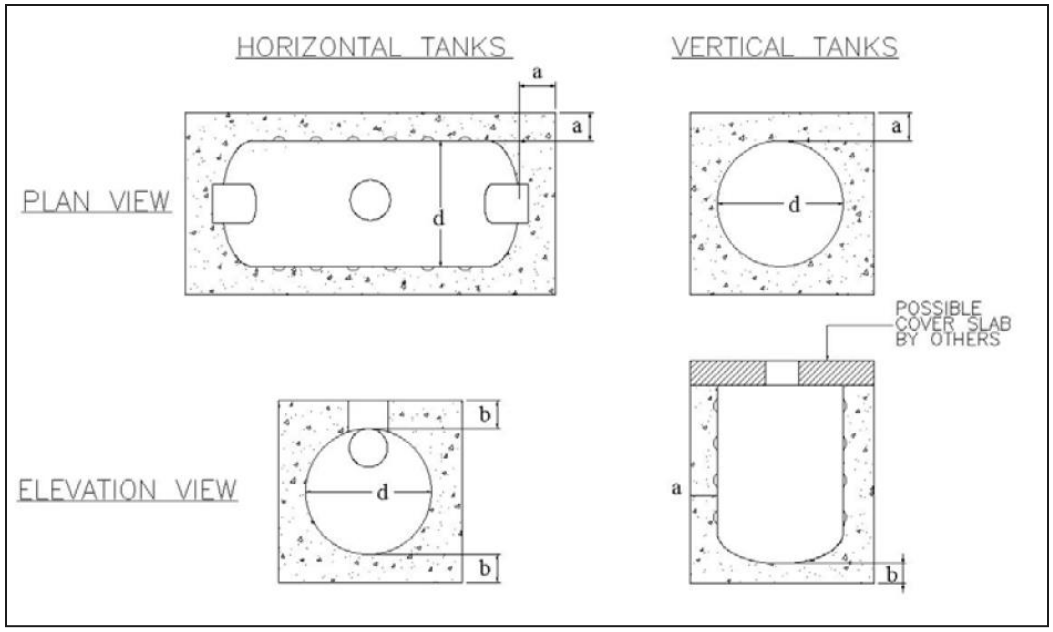
- **Costly but effective for high COD waters**

Efficiency vs. Frequency of Maintenance

- Prallel plate coalescers have lower efficiencies than Corrugated plate coalescers but require less frequent maintenance or media replacement due to fouling
- The waste water has to be characterized in the design phase: does it have a high content of silt? Is solid processing a required feature in addition to oil/water separation? Is oil recovery necessary?

Material of Construction of Shell/Tank 1

- Plastic (GRP / PE) – single or double walled shell
  - Concrete surround is required for GRP tank oil separator for underground installation.
  - The concrete thickness can be found in the installation guide provided by manufacturer.



TZA GRP OWS from Conder Environmental UK

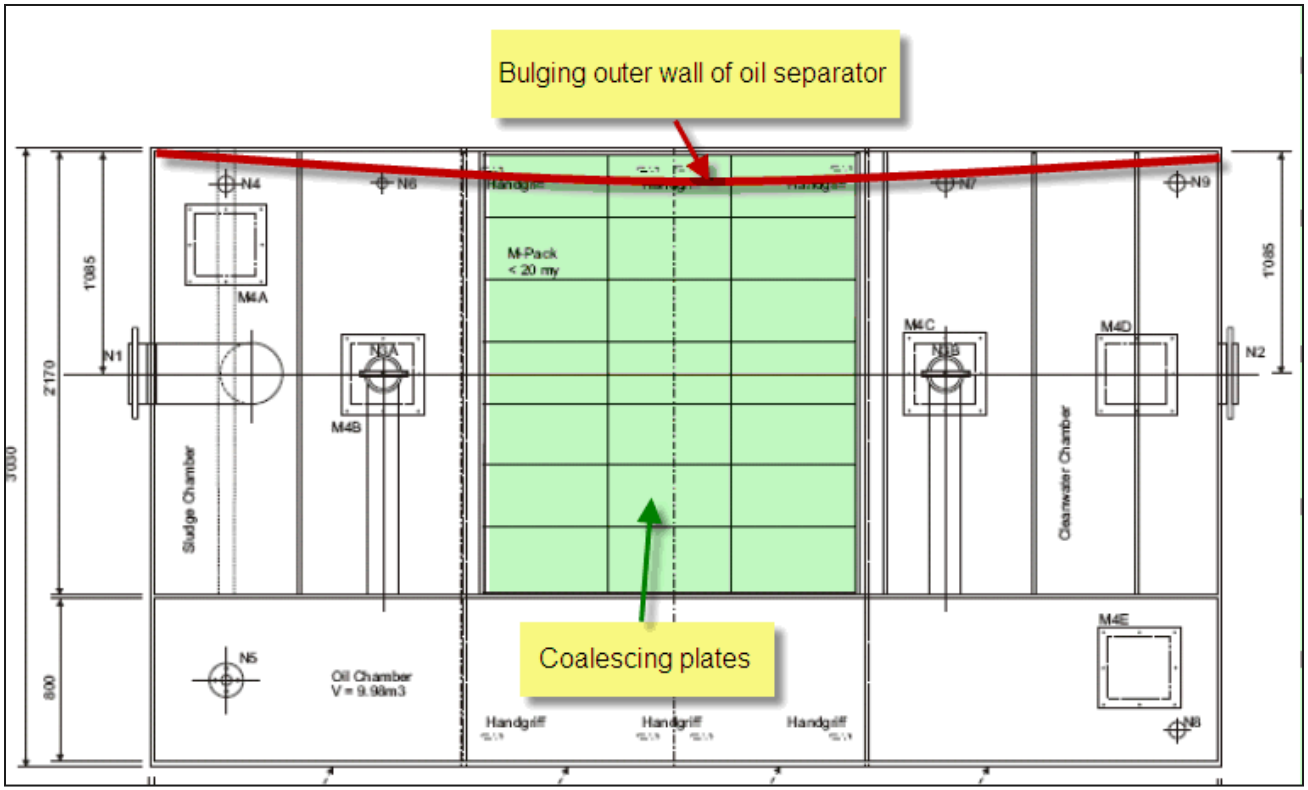
Material of Construction 2

- Concrete with Coalescing Media Pack

Material of Construction 3

- It is also possible to have the OWS made out of SS or Steel for above or below ground use (single or double walled shell - up to 30 years corrosion resistance)

Project Experience - Malaga



Project Experience - Malaga

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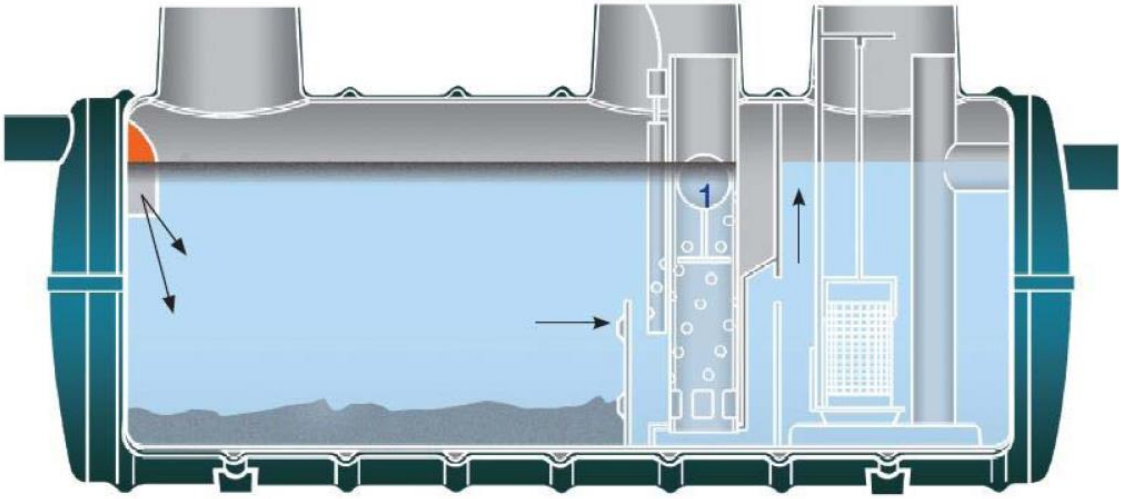
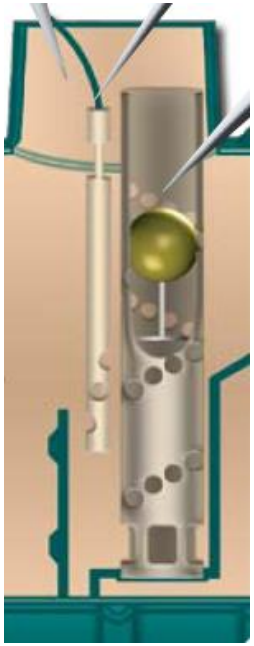
Automatic Closure Device (ACD)

- Full retention separators must be provided with an automatic closure device that will prevent flow passing through the separator when the quantity of oil in the separator exceeds the oil storage volume.
- If the automatic closure device is activated the operator should be alerted by a high level alarm so that immediate maintenance can be carried out.



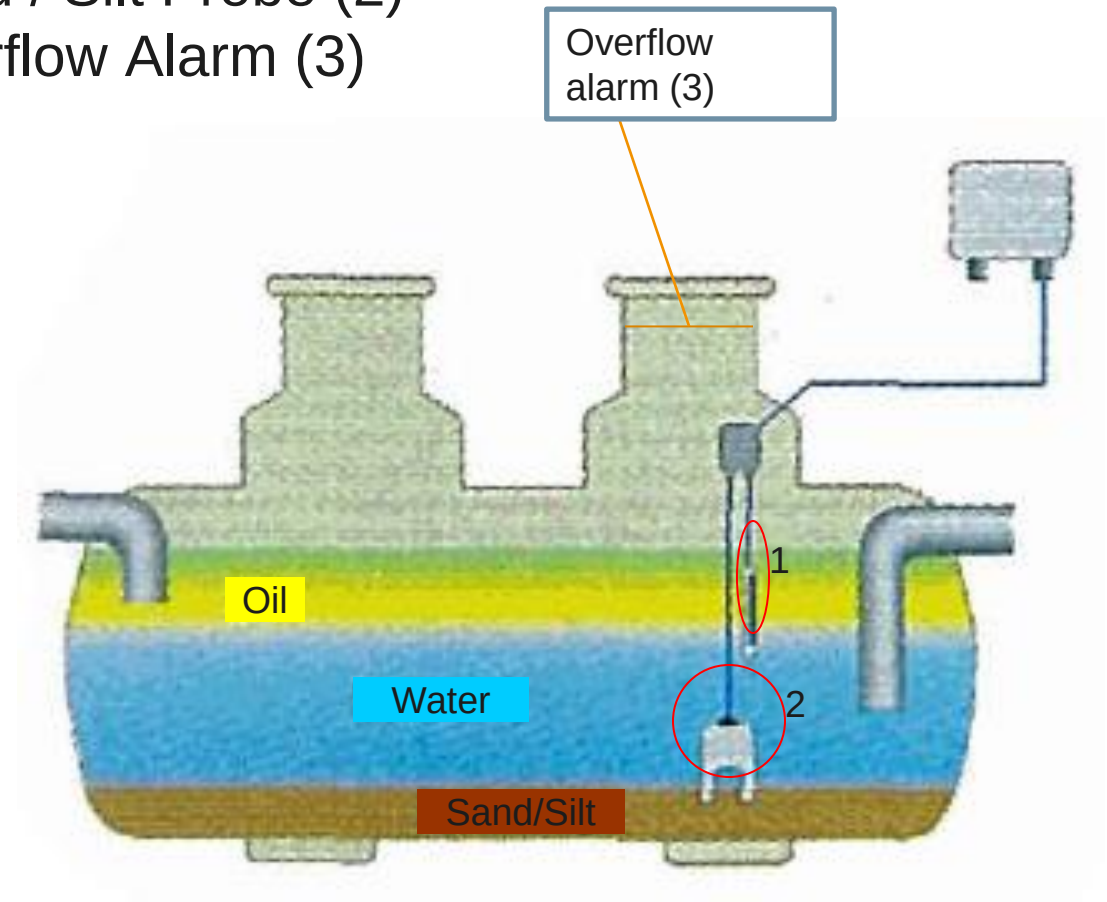


Alarm System - I

- According to the Environment Agency's PPG3 guidelines, all separators must be provided with a robust device to provide visual and audible warning (if necessary to a remotely located supervisory point) when the level of oil reaches 90% of the oil storage volume.
- This automatic warning device indicates that the separator is in need of immediate emptying for it to continue to work effectively.
- It is possible to have an additional alarm in case the OWS overflows (for example in case of high inflow and fouling of coalescer) or the sludge is too high and needs emptying

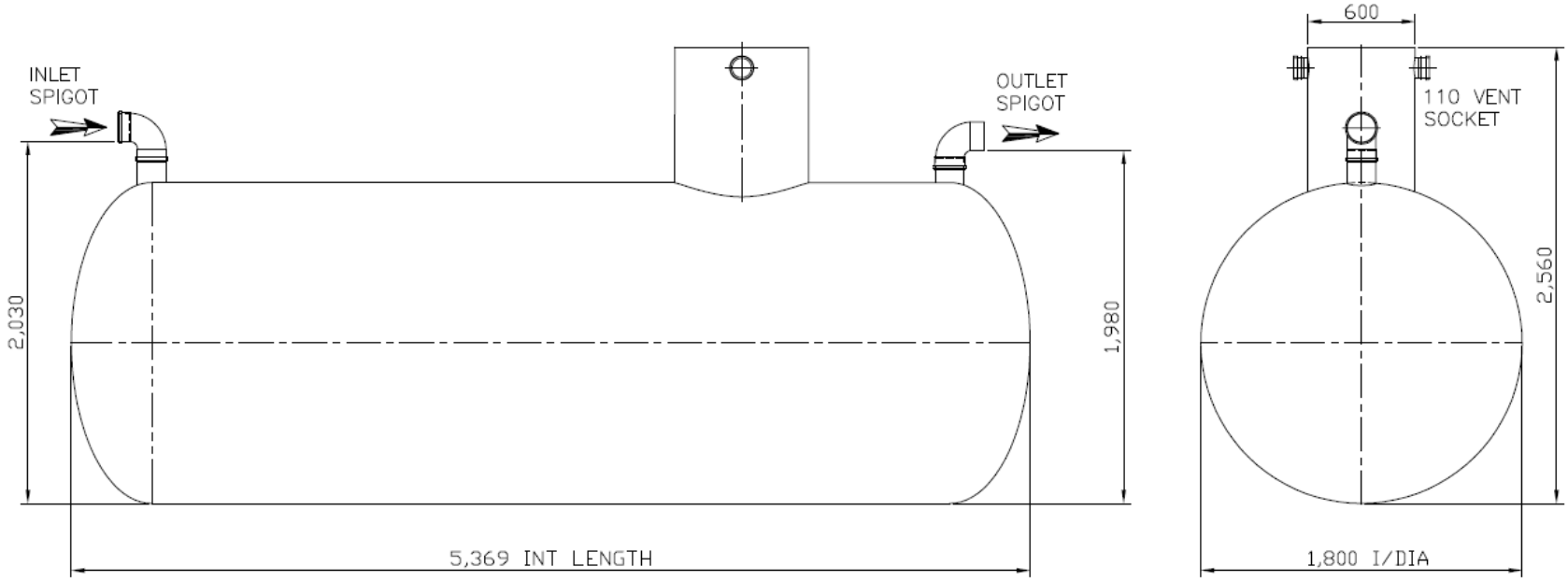
Alarm System - II

- Installation
  - Oil Probe (high and high high)(1)
  - Sand / Silt Probe (2)
  - Overflow Alarm (3)



Ventilation

- Appropriate ventilation to be provided when the separator is installed to retain flammable liquids. ATEX instruments a must in this case.



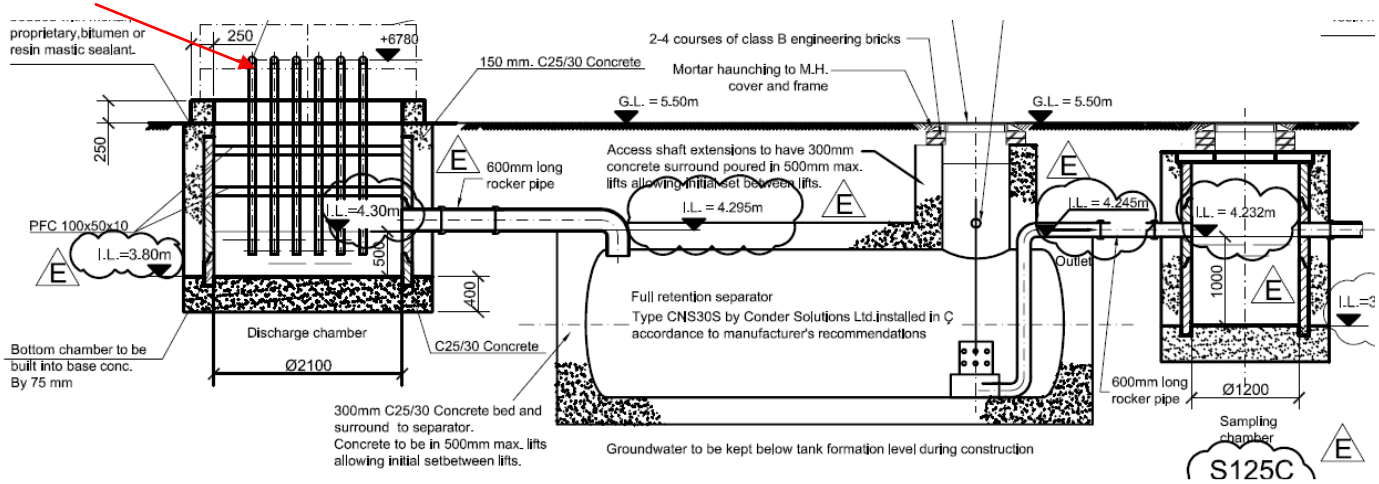
Oil Separator Arrangement – Gravity Inflow

- Incoming flow by gravity
  - The oil separator is integrated into the underground network system. As there is no turbulence occurring in the influent by gravity flow, then the drain can be directed into the oil separator without any presettling tank.

Oil Separator Arrangement – Pumped Inflow

- Incoming flow by pumping with pre-settling tank
  - The pumps used upstream of oil separator are to be low shear, non-emulsifying pump according to PPG3 and the separator is specifically designed to receive pumped inflows.
  - The pre-settling tank shall be provided in order to reduce turbulence before inflow to oil separator.

Incoming pipes



Maintenance

- The Environment Agency's PPG3 guidelines stipulate that, every six months, according to manufacturer's instructions, experienced personnel should:
    - Physically inspect the integrity of the separator and all mechanical parts
    - Assess the depth of accumulated oil and silt
    - Service all electrical equipment such as alarms and separator management systems
    - Check the condition of any coalescing device and replace it if necessary
    - Keep a detailed log of when the separator is inspected, maintained, emptied and serviced.
    - Keep in mind that Oil + Water + Time = Sludge
    - Important to have in mind the Total Cost of Ownership considering Capital and Maintenance Costs when evaluating offers

Additional Features

- It is possible to have heaters for cold climates. Heating assists the oil-water separation process
- It is possible to have dead-end filtration upstream of the oil water separator to remove silt
- It is possible to use high tech media such as **RECAM** as a polisher
- It is possible to have a built-in oil skimmer to skim the waste oil at the surface of the oil water separator
- It is possible to have a scraper at the bottom of the OWS to scrape off any depositing solids/sludge and deposit them in a hopper for collection
- It is possible to dose flocculating agents or emulsion breakers that improve the flocculation/coalescing process