

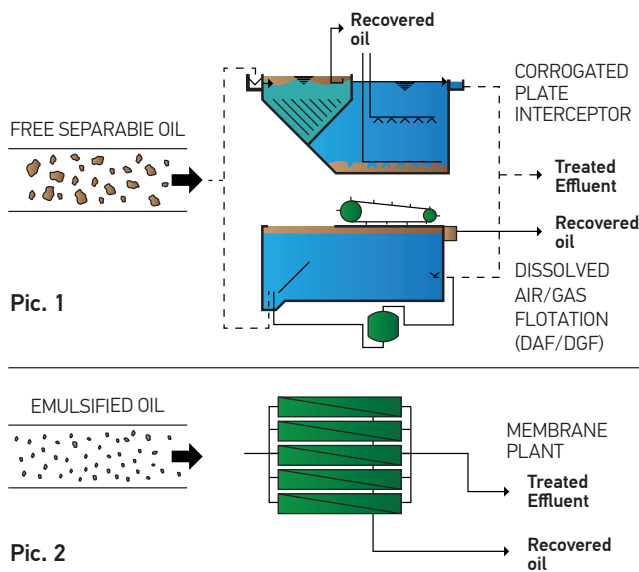
OIL & GAS INDUSTRY APPLICATIONS

PRODUCED WATER TREATMENT AND OIL RECOVERY

Esmil together with their partners have gained significant experience and know-how by conducting pilot studies to develop processes that result in the design and supply of systems for Oil and Gas Industries. At the heart of the process, is state of the art membrane separation and dewatering technologies.

RANGE OF TECHNOLOGIES

Our wastewater treatment technology, for Oil industry, is based on combination of conventional physicochemical pre-treatment methods, such as **Corrugated Plate Interceptors (CPI)** or **Dissolved Air/Gas Flotation (DAF/DGF)** followed closely by **Membrane Technologies** and polishing methods such as **Ion Exchange and Activated Carbon** to meet the most challenging discharge requirements.



Among technological equipment used in Esmil technology are:

Corrugated Plate Interceptors (CPI)

- Efficient gravity separators
- Removal of gross solids and free oil
- >75% free oil removal

Dissolved Air/Gas Flotation (DAF/DGF)

- Highly efficient air assisted separators
- Treatment of effluent from CPI's
- >95% free oil removal

Membrane systems

- Optimum emulsified oil recovery
- < 1ppm oil in permeate/treated water
- Low capital and operating costs

ESMIL TECHNOLOGY APPLICATION IN OIL INDUSTRY

Esmil offers a range of solid removal and oily-water separation process technologies, applicable across the entire range of effluents from upstream, midstream and downstream oil operations including:

- **Produced Water** – generated in the gas / crude oil separation process
- **Desalter Water** – generated during crude oil washing
- **Ballast Water** – for incoming sea tankers
- **Terminal and Refinery Process Drainage** – oil spills and general oily waste waters

Esmil offers systems for both onshore and offshore installations. Such services include Project Management, Design and Engineering, Specification and Procurement, Delivery and Installation.

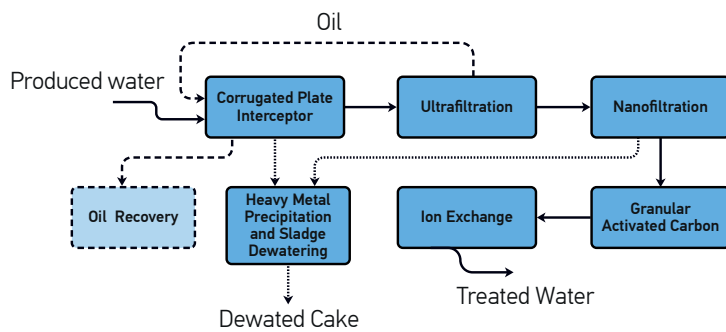
PRODUCED WATER TREATMENT

The Esmil philosophy for Produced Water Treatment utilises conventional separation processes for the removal of bulk contaminants, followed by a state of the art membrane separation and absorption process to achieve very low levels of contaminants in the treated effluent. This philosophy enables the plant to function reliably, even with wide range of variations in feed quality.

Conventional pre-treatment, such as **Corrugated Plate Separation, Hydrocyclones, Air Flotation or Sand Filtration** is used to remove the bulk of the oil and any suspended solids. The 'clarified' water is physically polished by membrane **Ultrafiltration**, which reduces oil concentration to less than 0.3 mg/l, and suspended solids to below the limits of detection.

OIL RECOVERY

Ultrafiltration reject is recycled to the front end of the process and the concentrated oil from CPI unit is reclaimed on site.



The oil and suspended solid free produced water is further treated using **Nanofiltration membranes**, which removes the bulk of heavy metals and organic compounds. The residual organics and heavy metals are then removed by **Polishing Activated Carbon Filter** and **Selective Ion-Exchange Unit**.

The various sludge and aqueous waste streams are combined before undergoing precipitation, flocculation and filtration, to produce a 'cake' for landfill and a filtrate that can be recycled through the process. The degree of treatment is designed to meet client specified limits, so that the treated water is suitable for re-use on site or to be discharged to sea.

TYPICAL TREATMENT EFFICIENCY

Parameter	Feed	Treated
Suspended Solids	100 mg/l	< 0.1 mg/l
Oils, Fats and Greases	15 mg/l	< 0.3 mg/l
Mercury	1 mg/l	0.0005 mg/l
Lead	0.5 mg/l	0.005 mg/l
PAH	1 mg/l	0.0002 mg/l
Iron	185 mg/l	1 mg/l
Sulphate	4093 mg/l	< 50 mg/l
Chromium	0.5 mg/l	0.1 mg/l
Zinc	25 mg/l	0.1 mg/l

ESMIL DESIGN PHILOSOPHY

Esmil strives to use the most appropriate solution to suit all your treatment and/or recovery requirements. Having a vast range of experience in treatment technologies, there are no limits to use a single technology which, allows for total flexibility. Therefore, the technologies that can be used include membrane bio reactors, aerobic treatment, media filtration, ion exchange and other membrane technologies across a range of effluents and industries.

As no two processes are equal, it is essential to follow a number of steps, as below to ensure that the tailored process is techno-commercially feasible.

- Lab scale trials to ensure the process feasibility
- Long term site pilot trials to account for the feed variation and real time data collection for design purpose
- Extensive plant design and OPEX calculations
- Build, Installation and Commissioning
- Comprehensive service support including maintenance and system upgrades.

REFERENCES

ESMIL have installed over 50 installations over the past 25 years, including:

- CPI Unit, 220 m³/h Oil Refinery, Kuwait National Petroleum Company, Kuwait
- CPI Unit, 420 m³/h Oil Refinery, M W Kellogg, Shell Oil, UK
- DAF Unit, 140 m³/h Oil Refinery, Hydrotechnik GmbH, Al Madain, Iraq
- CPI and Membrane, 240 m³/h Produced Water, Petrofac Ltd, Siberia
- DAF Units, Belt Filter Presses, 120 m³/h, Oil Refinery, Vankor Field, RF

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