



## **Separation Technology from GEA Westfalia Separator for Oilfield Applications**

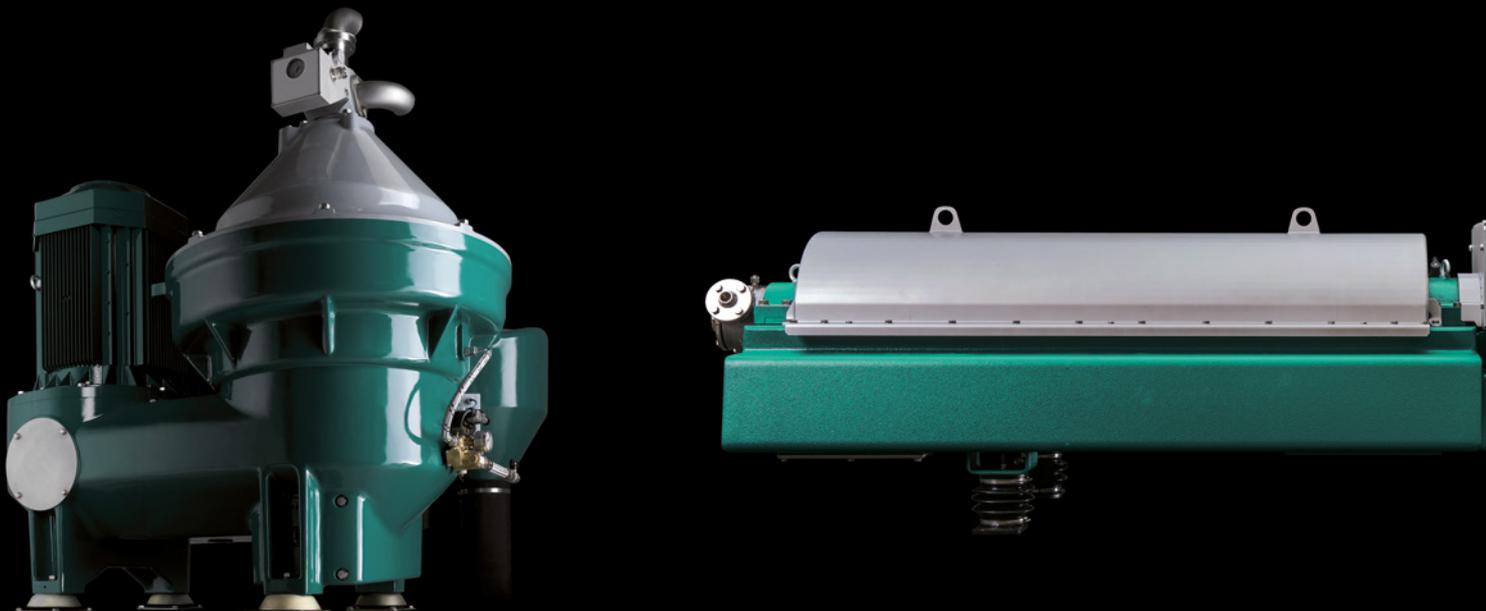
Protection of the environment

# Mechanical Separation Technology from GEA Westfalia Separator Enables You to Progress

Separators and decanters are centrifuges with which liquid mixtures can be separated with simultaneous removal of the solids.

Separators are vertical bowl high speed centrifuges, up to 10,000 G, which are primarily applied for the clarification and separation of liquids with and without solids content. The max. particle size that can be separated is 0.5 mm with a total solids content of 0.1 – 3 %. The throughput capacities of separators range from 50 to 250,000 l/h; a comfortable spectrum which accommodates the units for all process steps of separation technology.

When the solids content in the suspension to be processed is too high, up to 60 %, it's time to call in the decanters. They are often placed upstream of a centrifuge and achieve high clarification efficiencies and maximum dewatering. They are also employed for the separation of liquids with simultaneous removal of the solids. The essential preconditions here are a high bowl speed, up to 4000 G, a powerful drive for the scroll and a scroll speed that is automatically adapted to the solids concentration in the feeds.



## Available separator and decanter features

- High separation efficiency
- No impact from ship / platform movement
- Achieve down to 5 ppm oil in water
- IMO MEPC.107(49) approved
- Reduced need of chemicals
- Gastight design available
- Self-cleaning or manual centrifuges
- Nozzle centrifuges
- Ex-Zone 1 & 2
- ATEX approved
- Compact and robust design
- Plug and play system



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## High-Performance Equipment for the Oilfield Industry

### Overview of oilfield applications

Demand and requirements applicable for processing rigs and FPSOs for the oil industry are increasing. Operating reliability, weight and space requirements are major parameters. GEA Westfalia Separator Group supplies plug and play processing systems which comply with even the most stringent environmental requirements and feature the latest weight and space saving designs.

They handle continuous liquid-liquid-solids separation in a wide range of applications and a wide range of capacities. The centrifuges are specifically designed to cope with the needs and circumstances on site, with permanent reduction of costs.

Upstream			Downstream
On and offshore installations Oil & gas production			Oil refineries Gas treatment plant Tank terminal
<b>Drilling</b>	<b>Production</b>	<b>Utilities</b>	
Brine	Heavy crude oil	Bilgewater	Cat fines
Drain water	Drain water	Fuel oil	MEG
Drilling mud	Produced water	Hydraulic oil	Slop oil
Slop water		Lube oil	Slop water
Solids control			Tank bottoms
Tank cleaning			

# Drilling

## Mud/slop/drain water treatment system

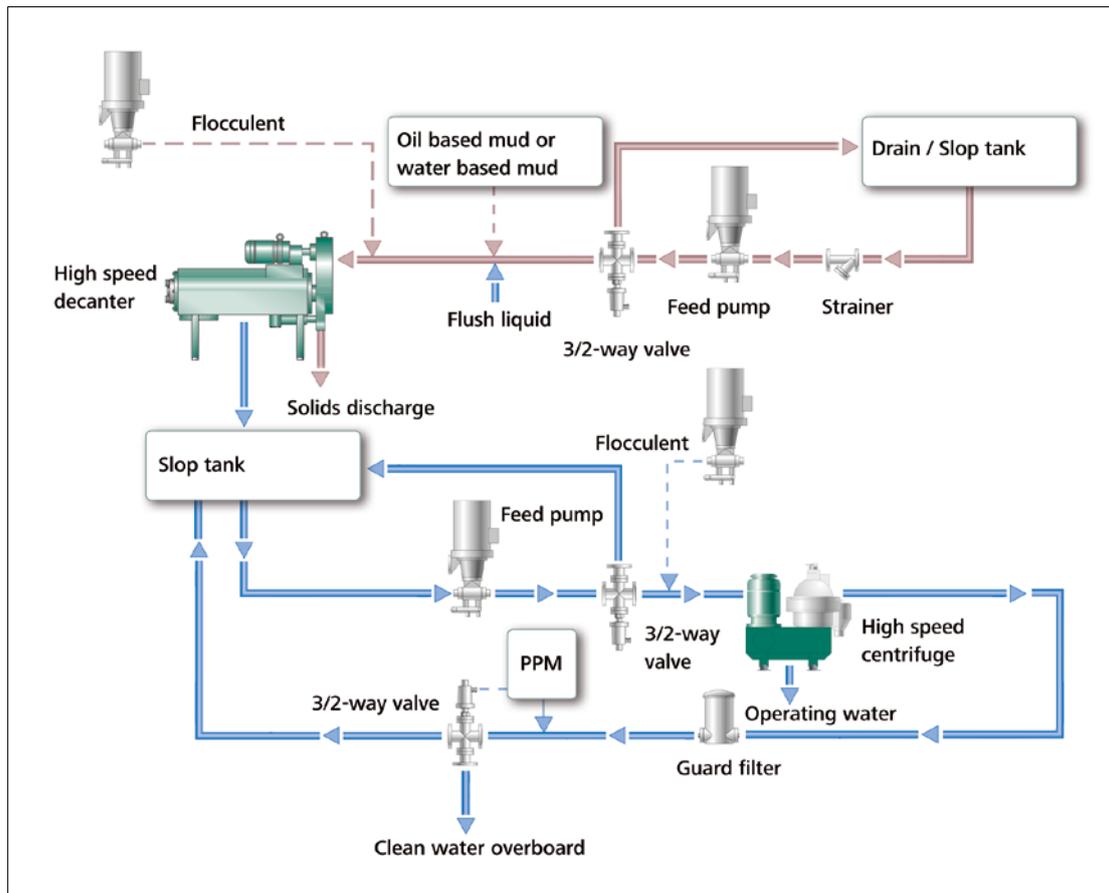
The higher demand for hydrocarbons is pushing us further into a tough environment. New high-tech rigs/FPSOs are developed to cope with these new challenges. Our contribution is to help you protect our fragile environment and to maintain the “zero-discharge” philosophy. GEA Westfalia Separator Group has a complete environmental system which reduces the discharge to sea to a minimum. A high efficiency slop treatment system will also have economic benefits as the costs for ship to shore and subsequent treatment are no longer required.

The treatment of slop is always a challenge as the slop tanks contain everything from drain and slop water,

oil spills, brine, bentonite, barite, cement, mud etc. This results in a variable oil and solids content.

To solve this challenge GEA Westfalia Separator Group has developed a complete system using the full capacity of both the decanter and centrifugal technology.

Our available decanters for this application have a low bowl angle for optimal thickening and a hydraulic scroll drive for maximum power. We have also the patented bowl design for handling of brine with a specific gravity of up to 1.5 sg.

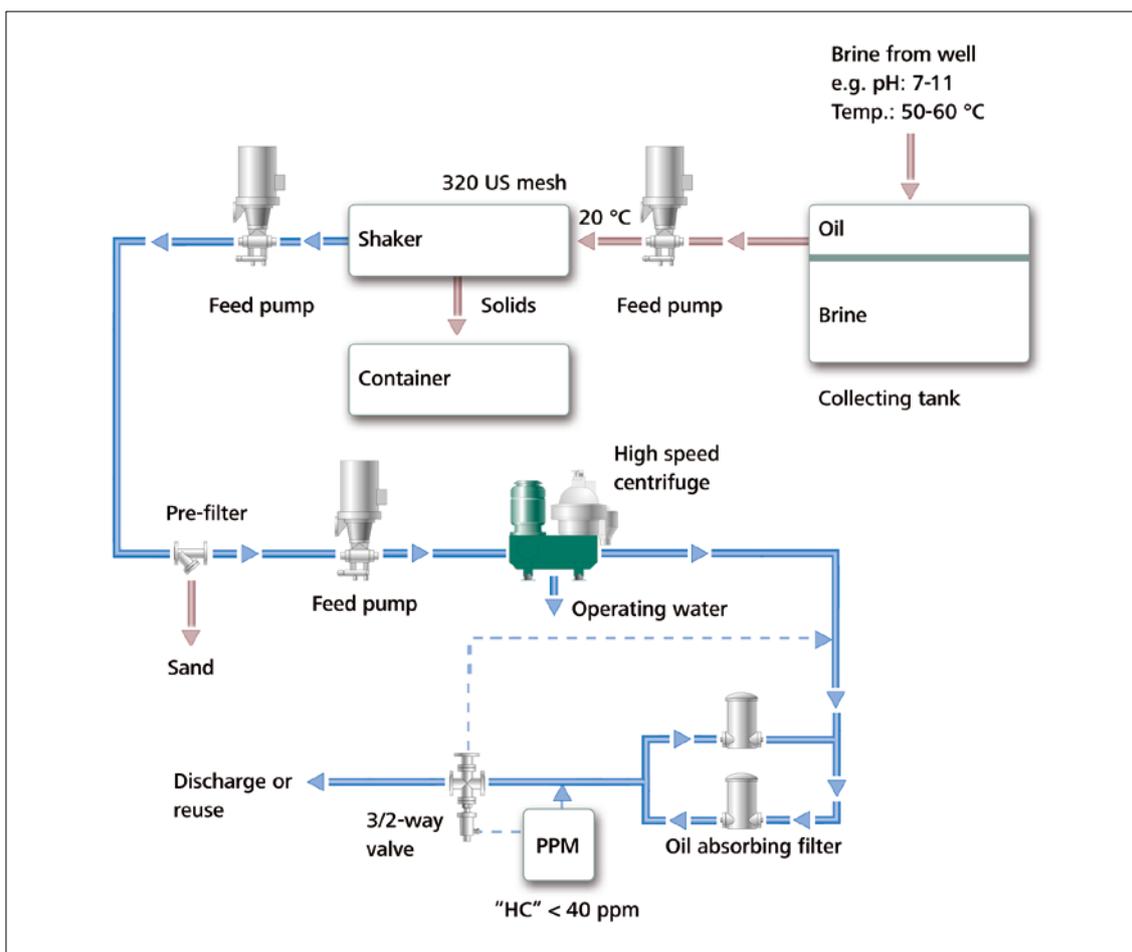
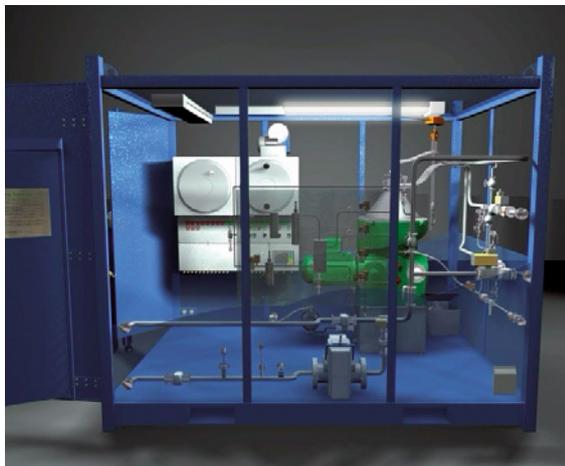


# Drilling

## Brine water treatment system

The first centrifugal separator has been installed on a rig to handle slop (oil containing SW, brine, soap, polymer pills etc.). No slop is now sent onshore. Only very little debris is left after the separation process. The capacity of the GEA Westfalia Separator Group system is 10 – 30 m<sup>3</sup> per hour. Up to 1.5 specific gravity is handled.

The separator has now been used for 8 wells, with an average saving of more than 250,000 € per well. Previously a flocculation process, DE-press and cartridge filtering and more personnel were required, still

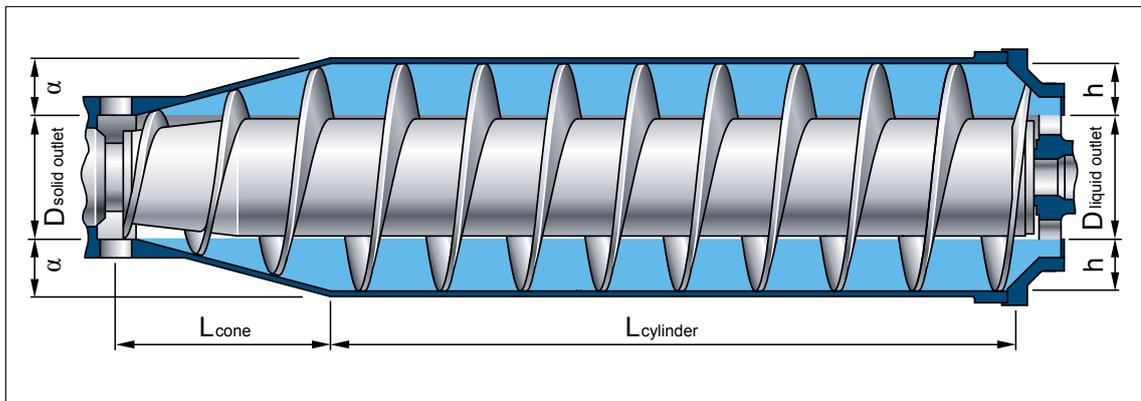


# Drilling

## High performance decanter technology

GEA Westfalia Separator Group has developed special decanters for treating drilling fluids. Apart from high-performing and top separation efficiency the decanter centrifuges distinguish themselves through safe operation and robust design. The decanter centrifuges are self-contained skid mounted centrifuge

systems on a single frame with integrated control panel. The decanters from GEA Westfalia Separator Group are suitable for installation in ATEX Ex-Zone 1 (Category 2G) Temperature Class T3 according to European Standards when treating Drilling Mud (classified as non-explosive product), or US equivalent class 1, Division 1.



### Deep pool concept

One of the major parameters in a decanter centrifuge is the pool depth in the bowl which describes the height of the liquid ring in the bowl.

### A deep pool results in

- Increased efficiency at reduced bowl speed
  - Increased operational life of parts
  - Less required torque to drive decanter scroll
  - Lower power consumption
- Enhanced performance
  - Throughput and efficiency comparable to bigger bowl diameter centrifuges
  - Smaller footprint

On-site experience confirms that the deep pool decanters from GEA Westfalia Separator Group perform with higher throughputs and better clarification than standard solids control centrifuges. Ultimately, this means lower costs through optimization of the separation process.

### Innovative drive concepts

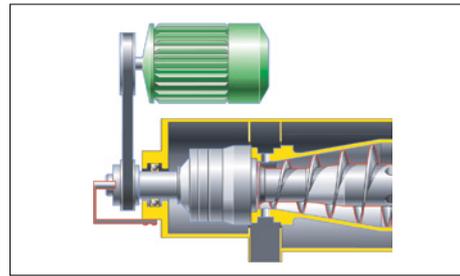
Flexible process management with simultaneous maximum availability are essential requirements for modern drive concepts.

The variety of applications in which decanters from GEA Westfalia Separator Group are used make different demands to the decanter drive system. In case of the oils & gas industry, flexible and precise regulation of the differential speed as well as a wide speed control range but also easy handling and robust design are particularly important. This is the only way to achieve extremely high solid concentrations and high separating efficiency. The zero-point drive and the full hydraulic drive have therefore become established in practice. With the newest drive generation, the GEA Westfalia Separator **summation** drive, all advantages have been integrated into one drive system. Automatic torque monitoring and control is standard for all GEA Westfalia Separator Group drive systems.

# Drilling

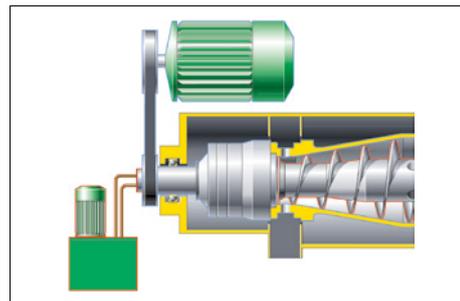
## Zero-point drive

Zero-point drive decanter centrifuges feature a simple and rigid design which is easy to operate. The input shaft of the drive is fixed. The differential speed is achieved by the gear transmission. The bowl and differential speed can be adapted by changing the pulleys.



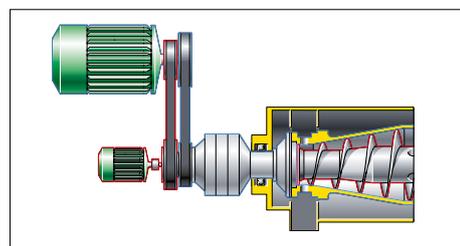
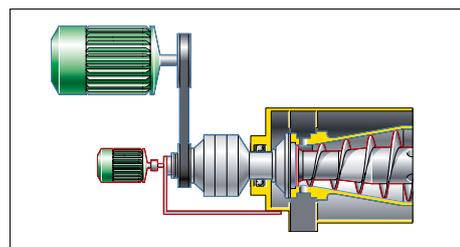
## Full hydraulic drive

The full hydraulic drive makes for exceptional flexibility of the decanter centrifuge and adaption to widely varying operational conditions. Stepless variation in bowl and differential speeds enables the operator to fine tune performance for optimum efficiency in solids removal, barite recovery, dewatering, mud recovery and weight control.



## GEA Westfalia Separator summation drive

The GEA Westfalia Separator **summation** drive always provides the full torque across the entire regulation range. It supplies only the power which is actually required, because the secondary motor is operated purely as a motor, and there are no braking effects. Accordingly, the drive does not require any backdrive and provides savings in terms of unnecessary conversion losses as well as belt drives, shaft loads and construction space. In the version used for higher differential speeds, the drive combines the output of the primary and secondary motor (summation) and thus minimizes energy consumption. Conversion to the higher differential speed range is possible without having to replace the gear. In both drive versions, the differential speed is provided over large ranges without any interruptions. The GEA Westfalia Separator **summation** drive automatically ensures constantly high solids concentrations even in conjunction with fluctuating feed conditions; it achieves minimum residual humidity in the solids discharge of the decanter and permits a maximum solids discharge volume by means of minimized differential speeds.



## Design features

- Deep pool concept for enhanced performance by optimized process configuration
- Tungsten carbide tiles or hard faced scroll for longer operational life
- Duplex bowl
- Stainless steel wetted parts
- Stainless steel hood
- Welded rigid frame
- Pillow block design for easy and fast service
- Exchangeable solid discharge ports for longer operational life
- Innovative and rigid drive systems for maximum solids concentration
- Torque monitoring for safe operation

# Production

## Crude oil dewatering and produced water de-oiling

When produced from the reservoir, crude oil contains contaminants such as water, suspended solids and water-soluble salts. These contaminants are damaging to refinery equipment, and must be removed before crude oil can be processed into fuels and other products.

Oil drilling operations can create large quantities of contaminated water known as “produced water”, or water that is produced from the well. Most underground oil reservoirs have a natural water layer called formation water, which lies underneath the hydrocarbons.

The dewatering of crude oil becomes more difficult when we talk about heavy crude oil from API 19 and higher densities. Here, the high g-forces of centrifuges help to avoid the use of chemicals and improve the separation.

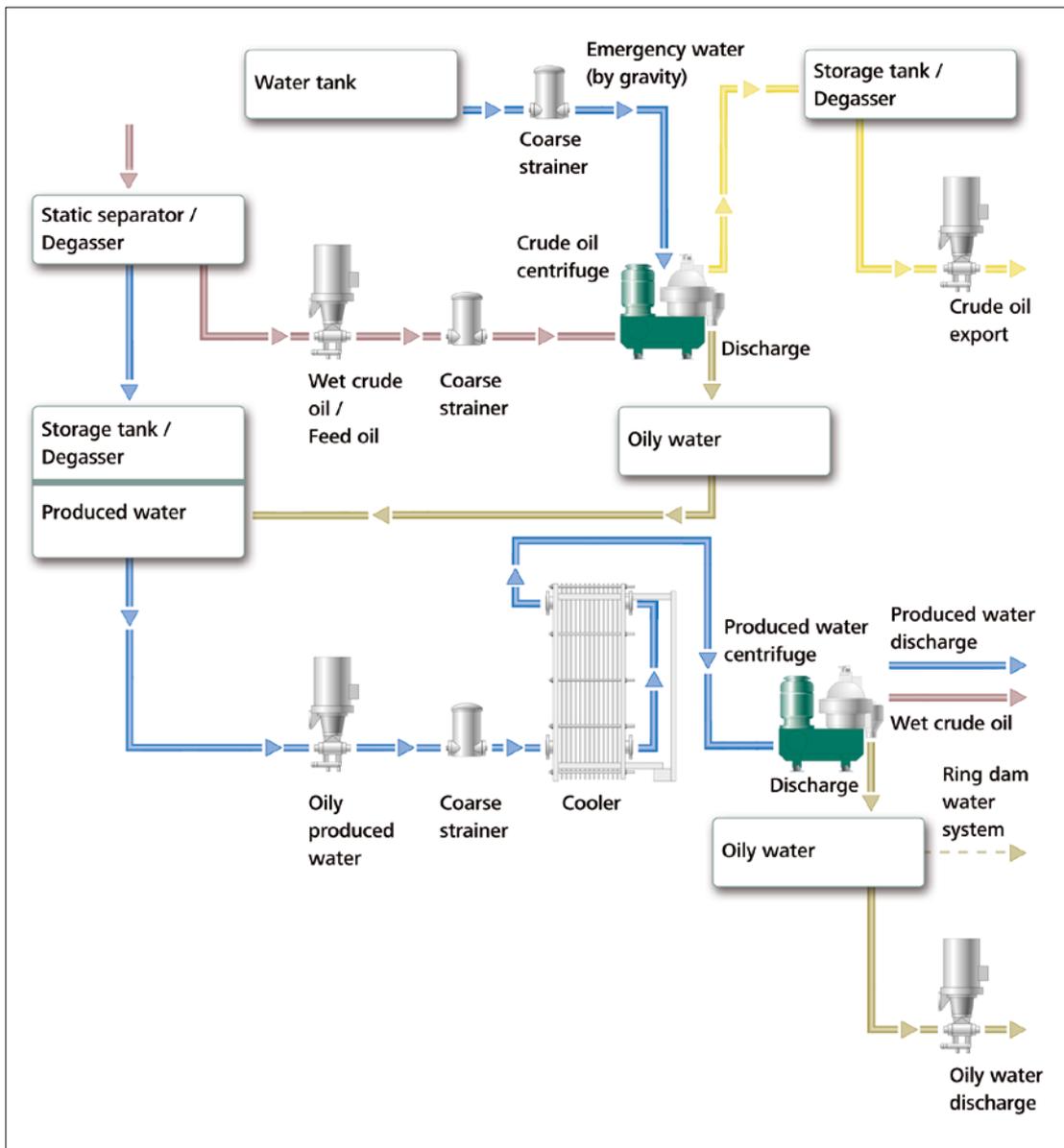
As a well ages and oil becomes difficult to remove, water or steam is injected into the reservoirs to help force the oil to the surface. Both formation and injected water eventually make their way to the top and are produced at the well head along with the hydrocarbons.

As the oil/water mixture is pumped out of the well, it is separated yielding the hydrocarbon product and the produced water. As the oil level drops in the reservoir, the amount of water injected increases to fill the void.

In the United States, produced water coming from oil wells is 8 times the volume of the oil produced. These volumes represent huge amounts of contaminated water that require economical and environmentally friendly methods of treatment so it can be re-used or safely disposed of.

Produced water volumes tend to increase dramatically as older oilfields pass their peak production. GEA Westfalia Separator Group has solved this challenge by making it possible to convert the centrifuges from crude oil separation to produced water separation.





### Utilities

- Demulsifier
- Fresh water
- Hot process water
- Instrument air
- Nitrogen

# Utilities

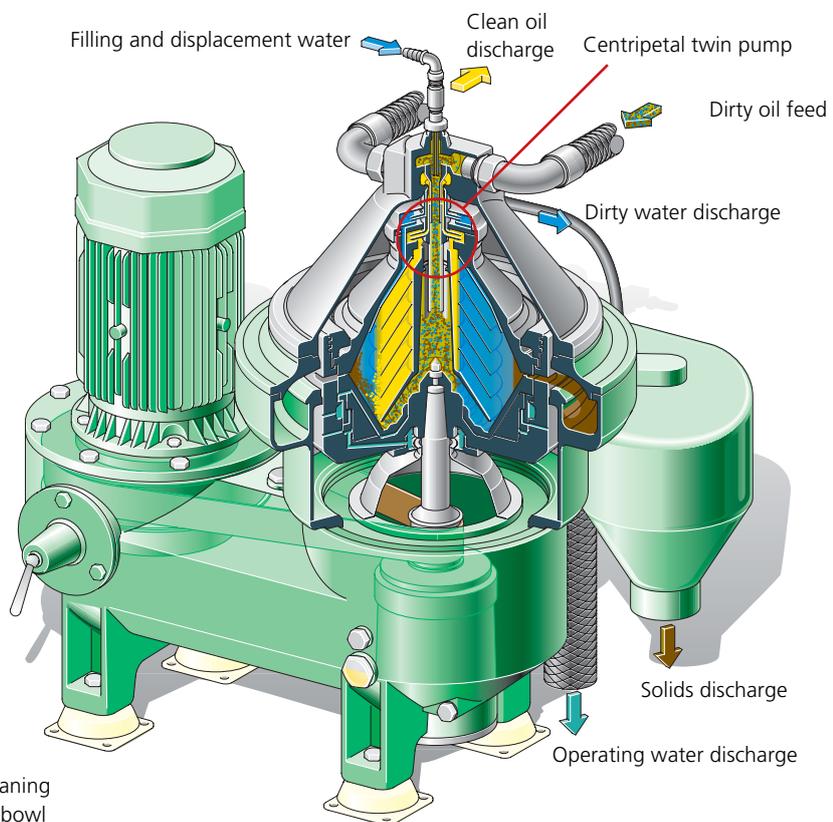
## Self-cleaning separators for MDO/LO/HFO treatment

Self-cleaning separators with disc bowl and automatic solids ejection are used where the percentage of solids in the oil is too high for manual cleaning. These are used mainly for the clarification and purification of fuel oils such as gas oil, diesel oil, heavy fuel oil and lube oil. Self-cleaning separators discharge solids automatically while the separator is running. This avoids the need to shut down the separator for frequent cleaning.

Self-cleaning separators operate continuously. Solids ejection occurs either by total or partial ejections, or a combination of both with additional self-cleaning of the disc stack. Labour intensive cleaning of the discs using CIP systems is not necessary. Optimum separation efficiency over long operating times is ensured. Maintenance work is required only after 8000 to 16,000 operating hours. The clean oil and the separated water are conveyed to the discharge under pressure by a centripetal twin pump.

### Features

- Automatic operation
- Continuous operating mode
- Self-cleaning effect of the bowl without CIP systems
- Highly concentrated solids
- High separation efficiency
- Can be used as clarifier and purifier
- Discharge of light and heavy phase under pressure by a centripetal twin pump
- Low noise level
- Belt drive
- EX design available



Bowl cross-section of a self-cleaning mineral oil separator with disc bowl

# Downstream Applications

## MEG particle removal

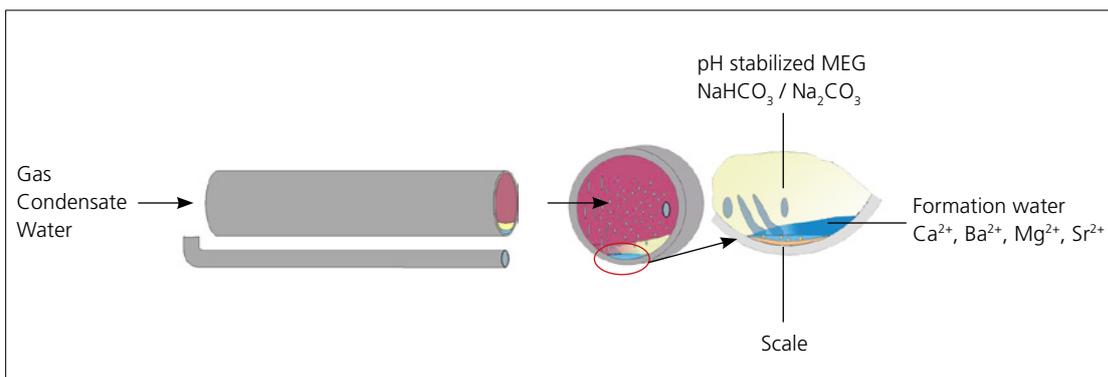
Proper hydrate management is vital for all field developments. For long distance gas/condensate tie-backs continuous injection of MEG (Mono Ethylene Glycol) in a closed MEG loop is the preferred solution.

By using carbon steel production pipelines, corrosion and corrosion inhibition strategy become important issues. Although the presence of the MEG itself gives a reduction of the pipeline corrosion rate, additional means are almost always required to avoid unacceptable corrosion.

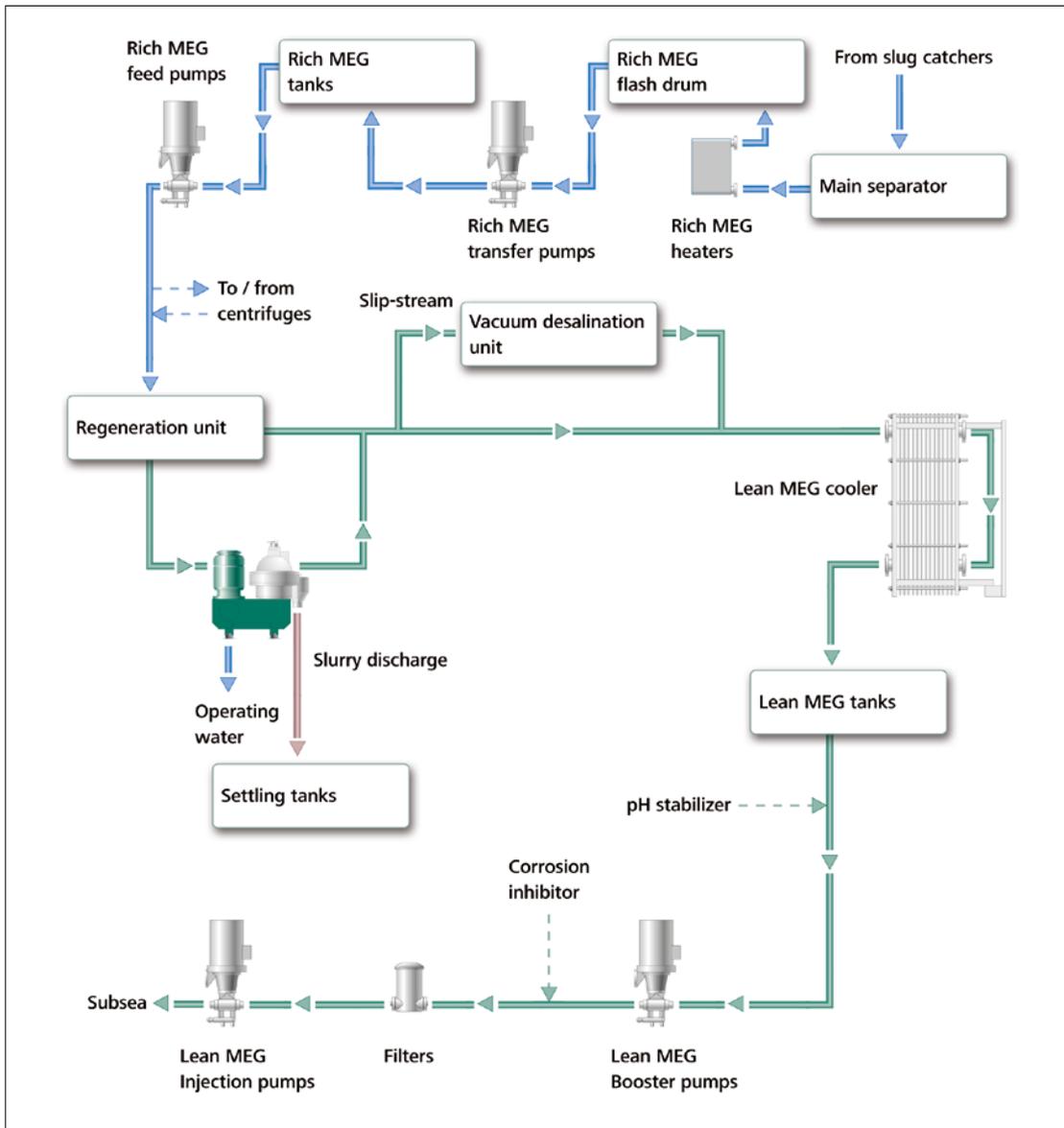
Even though alternatives for corrosion control like pH adjustment, addition of a corrosion inhibitor or a combination of the different alternatives are utilized, the pipeline will corrode and large amounts of iron ions will be formed. These iron ions, with other divalent ions like calcium stemming from the produced water, will enter the onshore plant. To prevent accumulation, and subsequently precipitation and scaling at unwanted locations, these ions must be handled with precaution at the onshore plant.

The nature of a closed loop MEG system, where water is continuously removed through conventional regeneration, requires a holistic approach to the challenge of ion and particle control and handling. Input from different disciplines like chemistry, corrosion, scaling, salt precipitation and engineering must interact in the design of the onshore plant, where the MEG is to be regenerated.

Flexibility regarding particle removal utilizing centrifuges has been built into the closed loop MEG system. The centrifuges can be run both up- and downstream of the MEG regeneration units. The reason why the base case solution is downstream the MEG regeneration units, is that the main overall concern to the project is high volumes of particles of a certain size present in the Lean MEG being injected sub sea having the ability to obstruct the injection devices. However, if problems are encountered in the MEG regeneration units that can be traced back to particles in the Rich MEG, the centrifuges can be run upstream the MEG regeneration trains.



MEG to bind condensate and salt in sub sea natural gas pipelines



Typical overall MEG system for gas treatment plants



# Downstream Applications

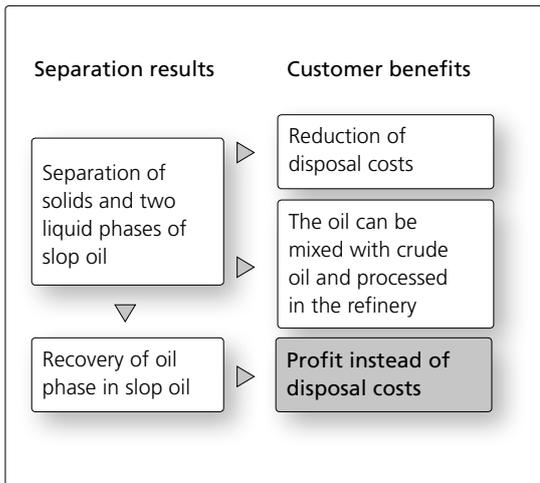
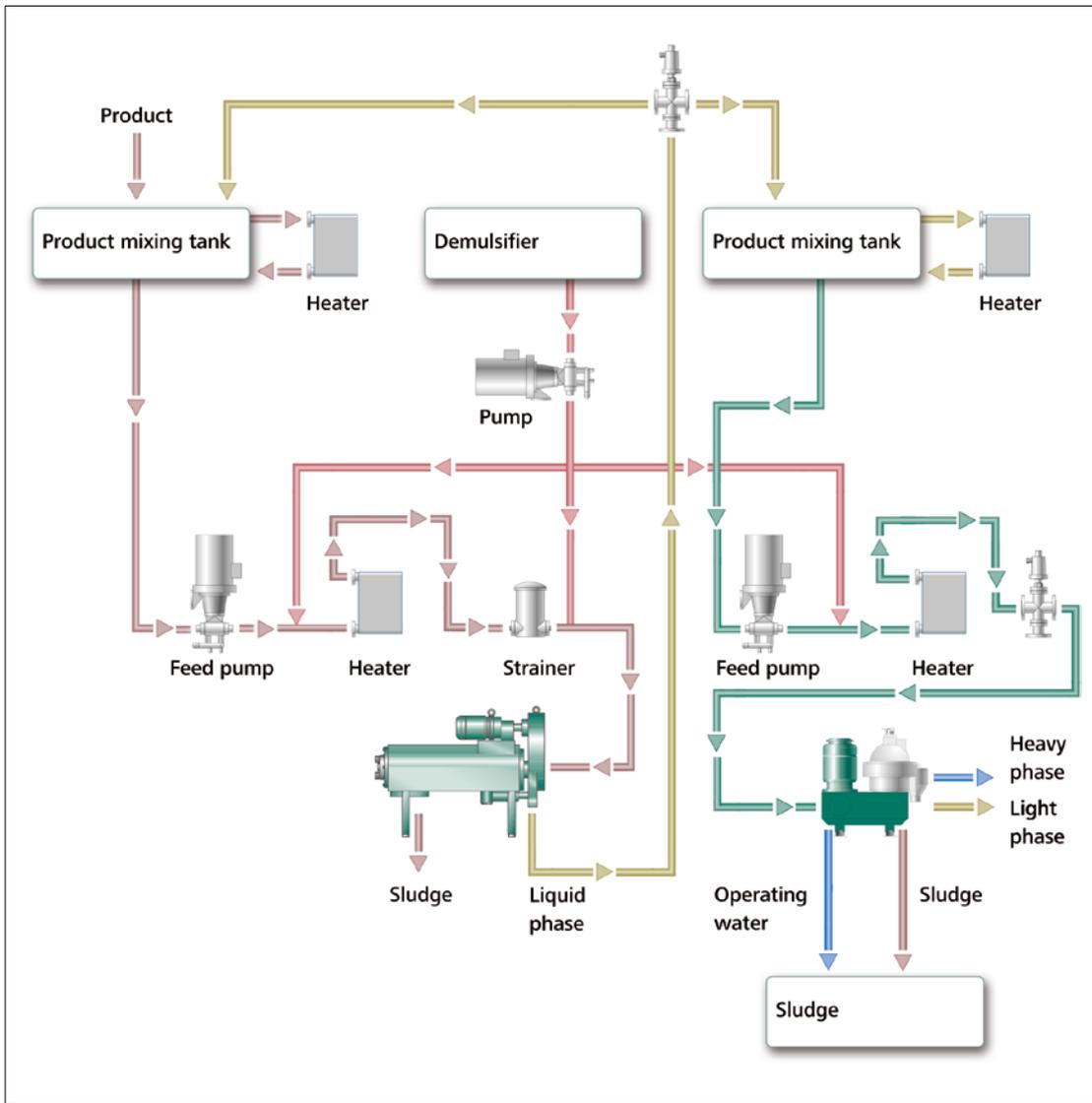
## Slop oil recovery – treatment solutions for refineries

In refineries all kinds of waste oils are produced, so-called slop oils. They come from drainages, residues and cleaning processes, especially cleaning oil tank bottoms. Most of these slop oils contain a high percentage of oil which can be mixed with crude oil to be processed in the refinery. If this slop oil is treated, not only disposal costs can be reduced, but profit can also be generated with the oil phase recovered from the slop.

As the oil as well as water content can vary from 10 to 90 percent and the solid content can vary from 1 to 10 percent, either disk stack centrifuges or decanters can be used for treatment of the slop oil. Decanters are normally used in feed with a solid content of more than approx. 5 percent (by vol.) A disk stack self-cleaning centrifuge can be used downstream of the decanter to polish either oil or water phase.

- 2-phase decanter to separate solids from liquid phases
- Disk stack self-cleaning separator to separate the two liquid phases
- Normally the oil phase is the one to be cleaned
- Optionally, the water phase can be treated further downstream to avoid disposal costs for oily water
- Oily water treatment systems from GEA Westfalia Separator Group can reduce the free oil content in water down to 5 ppm
- As an alternative, 3-phase decanters are available







## Downstream Applications

Systems for cat fines removal from residual oils in refineries

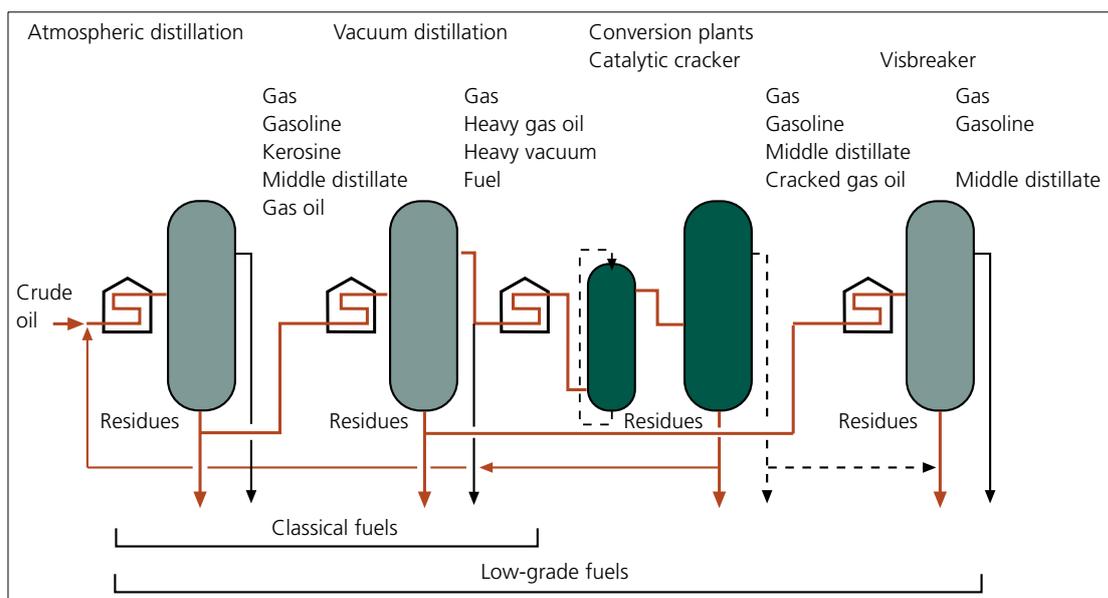
During modern refining processes the residual oils from vacuum distillation are sent to a cracking tower. The long hydrocarbons are cracked with the help of pulverized catalysts such as aluminum silicates which are mixed with the oil.

This cracking process takes place at a temperature of approx. 500 °C. A lot of these cat fines remain in the residues of the cracking tower and the distillates coming from the cracking process. These cat fines can be separated from the oils to recover them and/or improve oil quality.

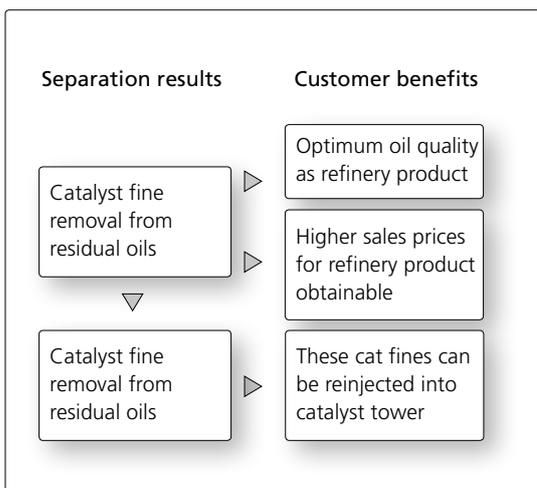
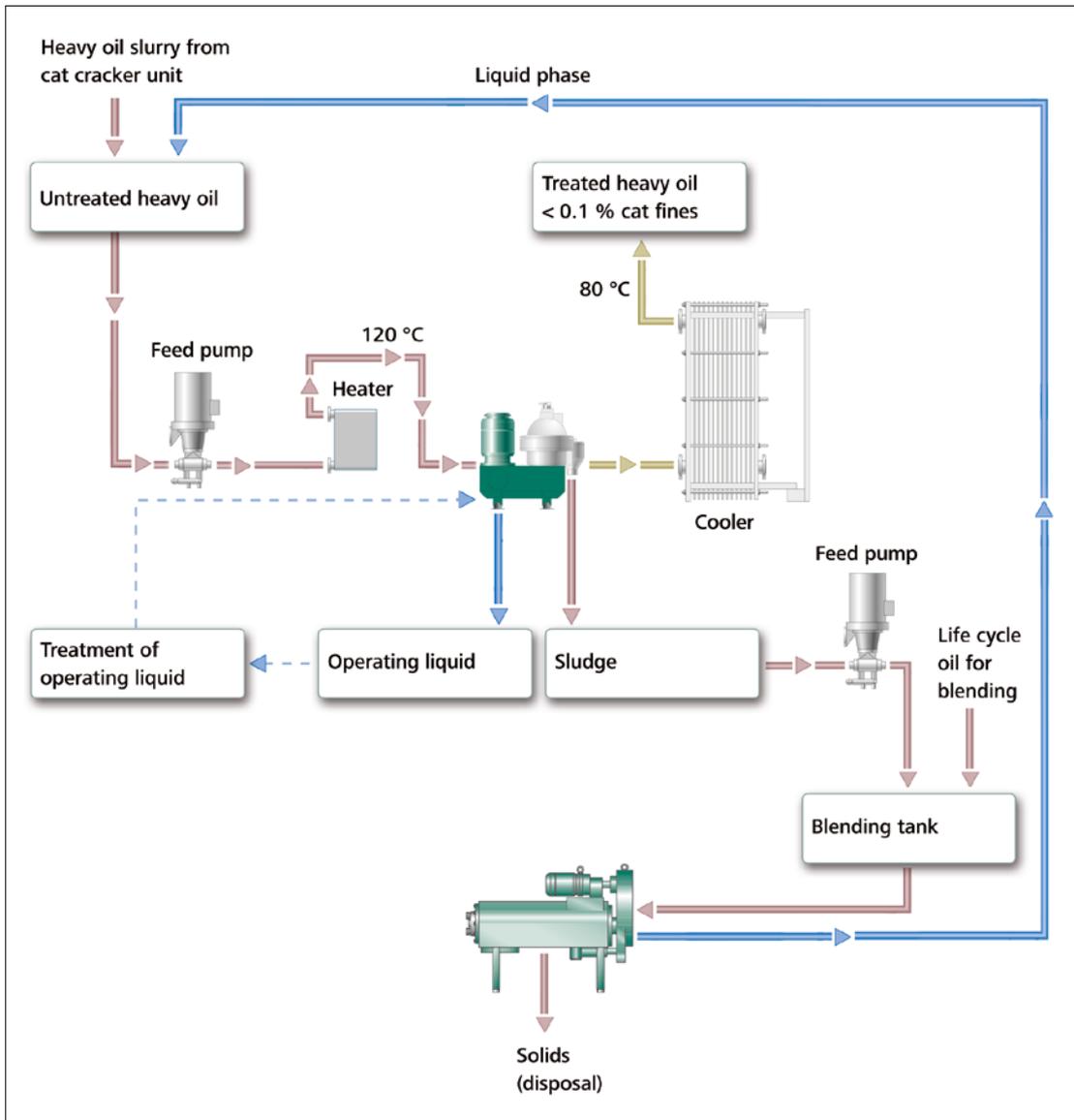
### Effective refining principle

Combining disk stack centrifuges and decanters

- Disk stack centrifuges for cat fines removal (operated as clarifier)
- Due to high product temperature oil is recommended as operating liquid
- Downstream cat fines concentration with decanters possible



Typical refinery process



# GEA Westfalia Separator minimaXx® – Sophisticated Technology in Confined Spaces

Hydraulic oil treatment plant

The part played by separators in the shipping industry has changed drastically in recent years. Not just stand-alone machines, but complete systems, even for small product streams, are required to face the increasing demands for high performance and low costs. The compact units with GEA Westfalia Separator minimaXx® separators were developed to fulfill these requirements and features.

The compact units of the minimaXx® class are made in a space-saving design. Each one is based on a separator of the minimaXx® family. This is mounted together with all necessary monitoring equipment in a mobile system.



## GEA Westfalia Separator ViscoBoosterUnit

Fuel oil conditioning system

Efficient operation of diesel engines operated with crude oil and heavy fuel oil requires optimum fuel supply. This key condition is accomplished by the GEA Westfalia Separator **ViscoBoosterUnits** for fuel conditioning.

This unit consists of a treatment system that meets the fuel requirements between the clean oil tank and injection system for the main and auxiliary engines in terms of the required injection viscosity and temperature. Supply and booster pumps are provided for a stable system pressure. The modules are designed for the different engines as well as to the required injection viscosity (approx. 10 – 24 cSt) and corresponding temperature (approx. 135 – 150 °C).

With the **ViscoBoosterUnits**, GEA Westfalia Separator Group offers a complete, compatible system from the service tank to the engine for safe and economic fuel oil treatment.

GEA Westfalia Separator **ViscoBoosterUnits** are supplied as package systems. They can be delivered as separate systems or as a complete module for the main engine and auxiliary engines for heavy fuel oil and diesel oil. They are designed for 24-hour unattended operation and meet the requirements of the classification societies.

(Please see first figure on page 19.)

# GEA Westfalia Separator SeaWaterDistiller

## Water desalination system

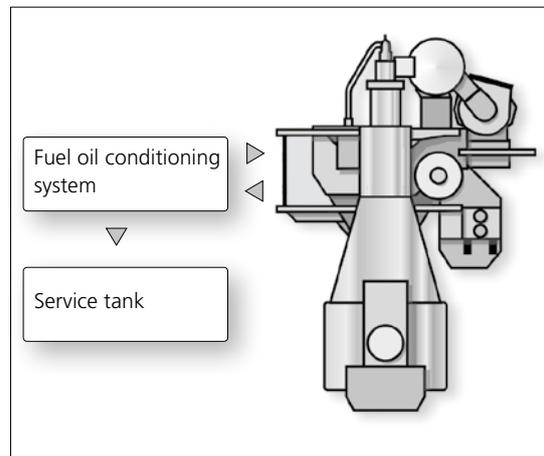
Sea water is fed through the condenser of the GEA Westfalia Separator **SeaWaterDistiller**, where it absorbs the latent heat of the condensing vapour. Some sea water is used as feed water for the evaporator whilst the remaining brine and non condensable gases are discharged using a combined ejector.

In the evaporator the sea water is heated up to the saturation temperature corresponding to the vacuum maintained by the ejector and a proportion is evaporated. The evaporator generally utilizes the waste heat from the main diesel engine jacket water, however, other heating media may also be used (e.g. steam, thermal oil).

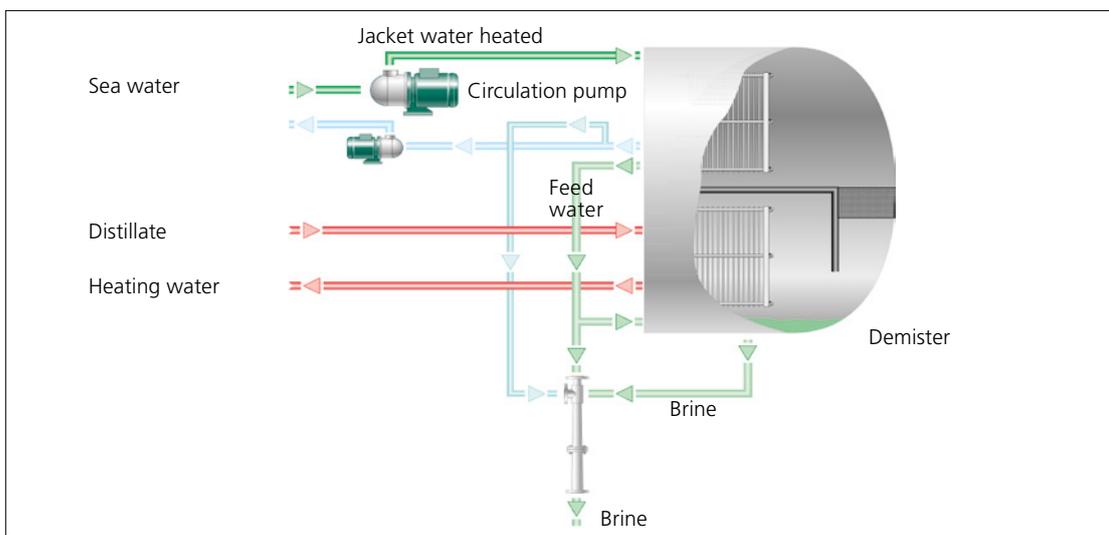
The vapour produced passes through the demister located in the upper casing to remove entrained droplets of water and is led to the condenser. The distillate is drawn from the condenser by the distillate pump and discharged through the salinity measuring unit. Depending on the residual salt content of the distillate, it is either led to the distillate tank or, if the maximum allowable residual salt content is exceeded, back to the evaporator. All parts of the GEA Westfalia Separator **SeaWaterDistiller** in contact with sea water are constructed of corrosion-resistant materials (CuNi, stainless steel). The plates are made of titanium.

### Features

- Compact
- Easy to operate, fully automatically controlled
- Reliable
- Low weight
- Low maintenance costs
- Integrated anti-scaling system
- Corrosion resistant materials
- High performance



Fuel oil conditioning system with VBU (above) and single stage evaporating system (right)





*We live our values.*

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.

## **GEA Mechanical Equipment**

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