



# SLOP OIL AND OILY SLUDGE RECOVERY

Separation technology for upstream  
and downstream applications

# GENERATING PROFIT FROM SLOP OIL

In upstream and downstream processes all kinds of waste oils / sludge are produced, the so-called “slop oils” or “oily sludge”.

**These streams are generated from residues and processes, such as:**

- Oily sludge from DAF units
- Bottom sediments from API separators
- Lagoons and oil pits
- Tank bottoms
- Desalter of spec products
- Marpol sludge

Most of these sources contain a high percentage of oil, which can be recovered as valuable products; not to mention the economic and environmental aspects of reduced waste volumes.

## **The challenge**

These products are generally difficult to manage, due to their high solids and emulsion content and high viscosity.

The slop oils can have variations in their composition and can contain 10 – 70 % oil, 30 – 90 % water and 5 – 20 % solids. The oil viscosity can be very high and reach values of up to 1000 cSt / 50°C. The specific gravity of the oil (oil density) can vary from 0.8 to 0.98 g / ml. In addition, low pH values and high chloride concentrations are other challenges. Furthermore, other factors such as abrasive particles (sand), organic solids and the presence of asphaltenes must be taken into account.

Unless this sludge is treated on-site, it either has to be incinerated, or sent to specialized treatment plants for further processing / disposal. Since this waste is also hazardous to the environment and difficult to transport, it is costly to dispose for the oil industry, driving a high demand for services that are able to process oily sludge in an efficient manner.

Slop oil treatment also recovers hydrocarbons that would otherwise be lost, generating additional value.

**Slop oil treatment installation**

GEA scope: Decanter centrifuge OCF 4000 and centrifuge unit with 2 x OSE 80 high-speed, self-ejecting centrifuges. Capacity 10 – 15 m<sup>3</sup> / h.



# THE GEA SOLUTION

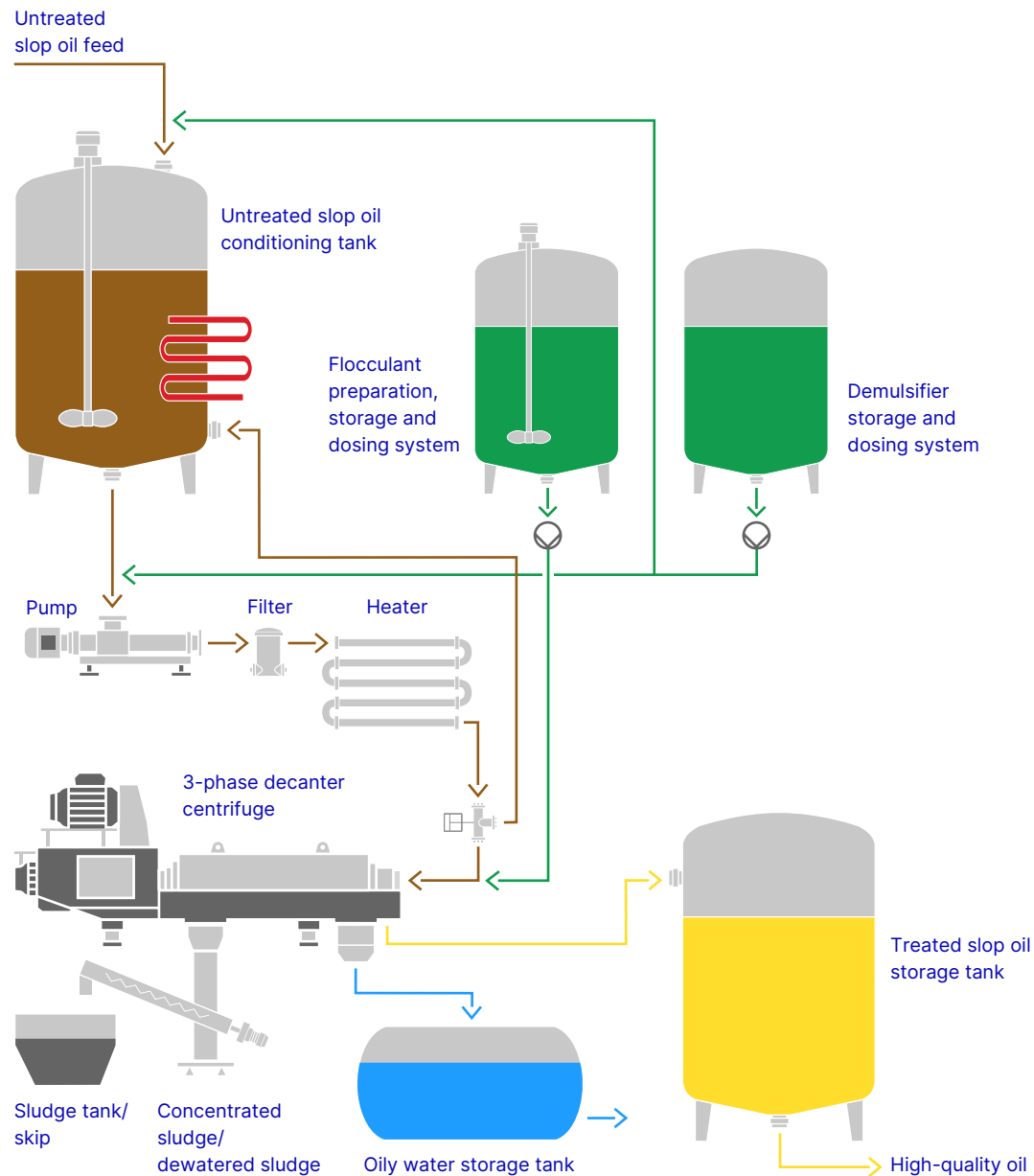


As an alternative to cost-intensive disposal of slop oil, GEA has developed a method to recycle the oils in an environmentally friendly way. The advantages for our customers: value creation by 80 – 95 % recovery of saleable hydrocarbons and the reduction of overall disposal costs.

The technical solution to recover the valuable oil and to minimize its environmental impact is to combine mechanical separation in several stages with heating and enhancement of the separation effect by chemicals.

Depending on the feed product composition and depending on the individual requirements, each slop oil system can have its own process solution.

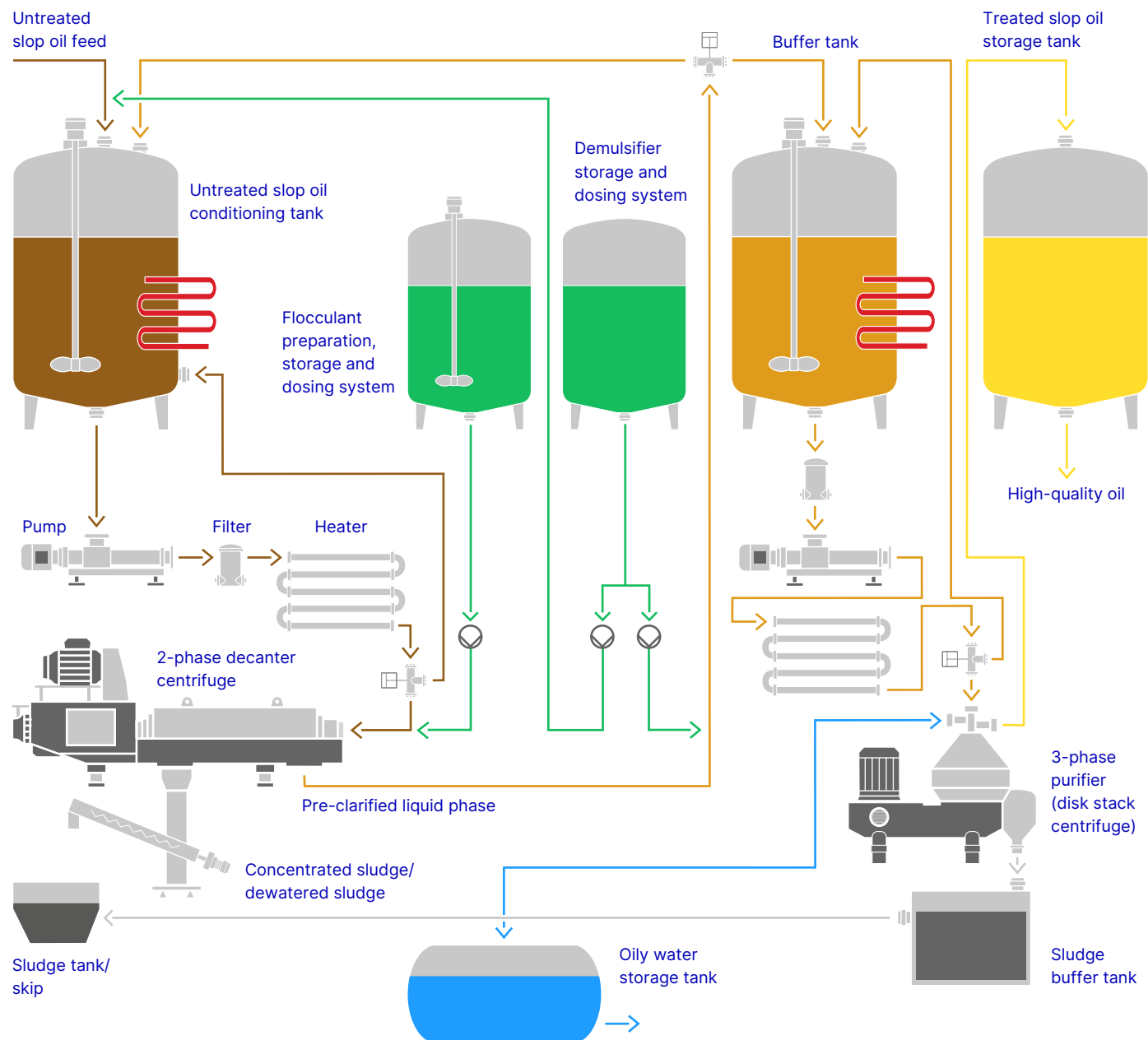
The existing variations of slop oil mean that both disk-type and decanter centrifuges from GEA are used. The decanters are primarily used when the proportion of solids in the feed makes up more than 2 % of total volume. In the downstream process, the self-cleaning disk-type separators perform the task of polishing the water or the oil phase.



## Single-stage treatment with 3-phase decanter centrifuges

If the feedstock material has properties that de-watering (sludge removal) with simultaneous oil and water separation in one stage can be efficiently processed, 3-phase single stage decanter centrifuges are the preferred solution.

If the feedstock is more difficult to treat, or if requirements regarding the oil quality are more stringent, a 2-stage treatment becomes a more viable process solution.

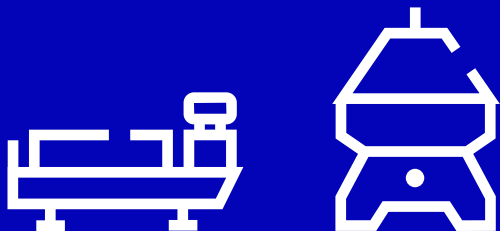


## Double-stage treatment with 2-phase decanter centrifuges and disk stack centrifuges

The high-speed disk stack machines processing the decanter centrate phase separate the ultra-fine particles and simultaneously remove the water content to the maximum. This results in a revenue generating opportunity, as oil can be merchandized similar to crude oil.

GEA has also the expertise to provide the further advanced 3-stage treatment process with an additional treatment stage for the water purification (de-oiling of water phase). This might be an option for processes or locations where water treatment is required.

# GEA CENTRIFUGE EXPERTISE



With an experience of 130 years and more than 3500 applications, GEA is the market leader in centrifugal separation. In the oil & gas industry our centrifuges can be found upstream:

- In refineries for the efficient dewatering of crude oil to reliably meet operational specifications
- On drilling rigs, treating drilling fluids including barite recovery
- On drilling rigs and vessels treating all kinds of deck drains, slop water and produced water to protect the maritime eco system

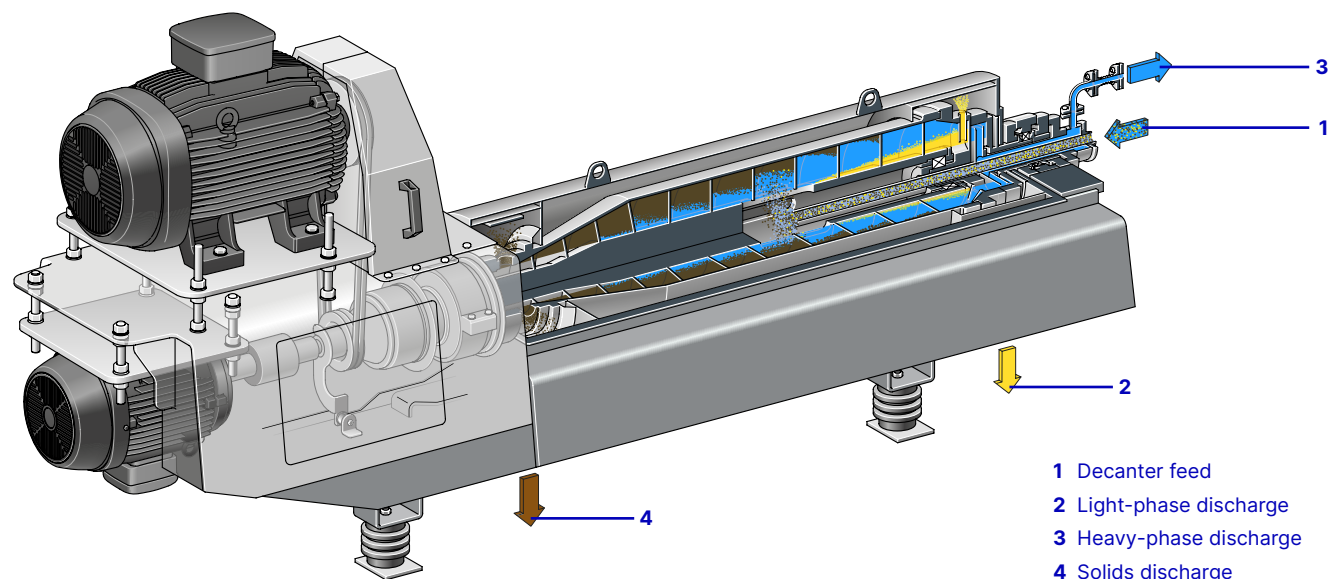
For downstream processes GEA offers centrifuges for the recovery of cat fines and the treatment of slop oil. Our centrifugal separators and decanters handle large volume streams with maximum efficiency and smallest space requirements.

## Decaners: workhorses for high solid content

Working capacity decanter centrifuge type GEA ecoforce CF

	Capacity [m <sup>3</sup> /h]									
	1	5	10	15	20	25	30	35	40	
CF 3000										
CF 4000										
CF 5000										
CF 6000										
CF 7000										

### 3-phase decanter centrifuge



When the solids content in the suspension to be processed is higher than 2 % it is time to call in the decaners. They are often placed upstream of a disk stack 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, with 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. They work with a horizontal bowl and scroll and come in 2-phase or 3-phase design.

GEA decanter centrifuges are available in a wide range of diameters and hence can handle different flow rates (see diagram).

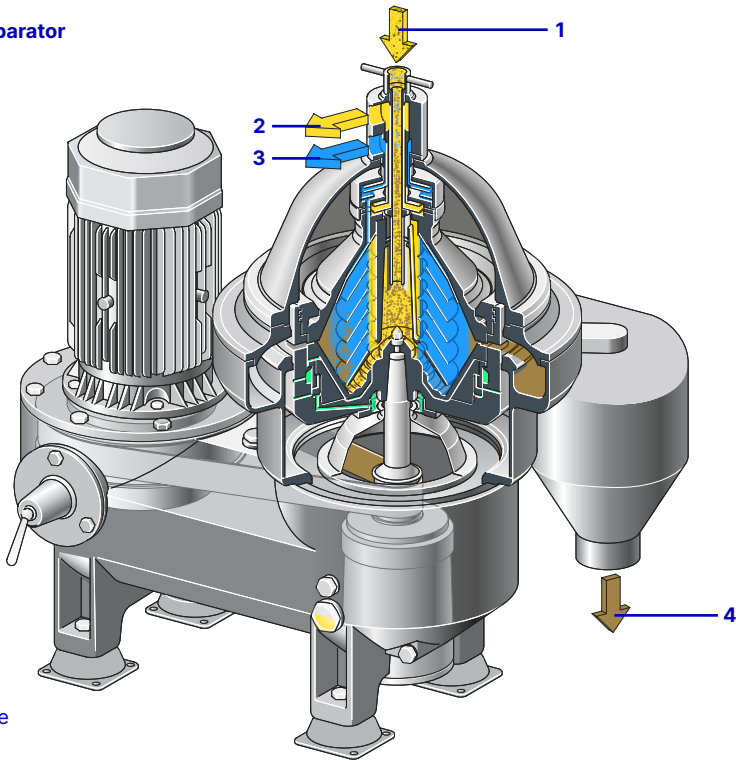


## Separators: high g-force makes for clear cuts

Working capacity disk stack centrifuge type OSE

	Capacity [m³/h]															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
OSE 20																
OSE 40																
OSE 80																
OSE 120																

Self-cleaning mineral oil separator  
with disk stack bowl



- 1 Product feed
- 2 Treated oil discharge
- 3 Separated water discharge
- 4 Solids discharge

Separators are vertical bowl high-speed disk stack centrifuges, they develop up to 10,000 G and are primarily applied for the clarification and separation of liquids with and without solid content. The maximum particle size that can be separated is 0.5 µm with a total solids content of 0.1 – 2 %.

High-speed state-of-the-art 3-phase self-ejecting disk stack centrifuges are used to polish the oil and the water phase in case it becomes necessary.

The working capacity per machine size depends on the feed conditions such as feed viscosity and solids content.

# GEA – THE SPECIALISTS IN SLOP OIL TREATMENT

Our understanding of slop oil, oily sludge and emulsions is broad. We have gained over many years the knowledge of the variations, both of the chemical and physical product characteristics. Our solutions are often unique and always reliable. References in major oil-producing countries by leading oil producers underscore our expertise in addressing the often complex problem of slop oil treatment.

Engineering documentation and calculations, right from the start of a project development, help our customers to make the right decisions.

## Advantages and benefits at a glance

**Recovery of the hydrocarbon phase containing a minimum amount of water and only very small traces of ultra fine sediments (BS&W usually between 0.1 and 0.5 %)**

- High revenue for recovered oil (resale)
- Recovered oil can be fed back to the refinery feedstock

**Wide flexibility regarding treatable product profiles**

- Even higher viscose slop (residual) oil can be handled
- Virtually no limitation regarding water and oil content in feed product
- Separation of variable solids content and very small particles (1 – 10 µm)

**Reduction of oil content in the separated water down to  $\leq 15$  ppm**

- Water can be discharged to the environment or directly to existing waste water treatment plant
- Reduction of disposal costs
- Environmentally friendly solution

**High concentrated sludge with the lowest possible rest oil content at system outlet**

- Considerable reduction of disposal costs
- Minimized volume of sludge for disposal
- Environmentally friendly

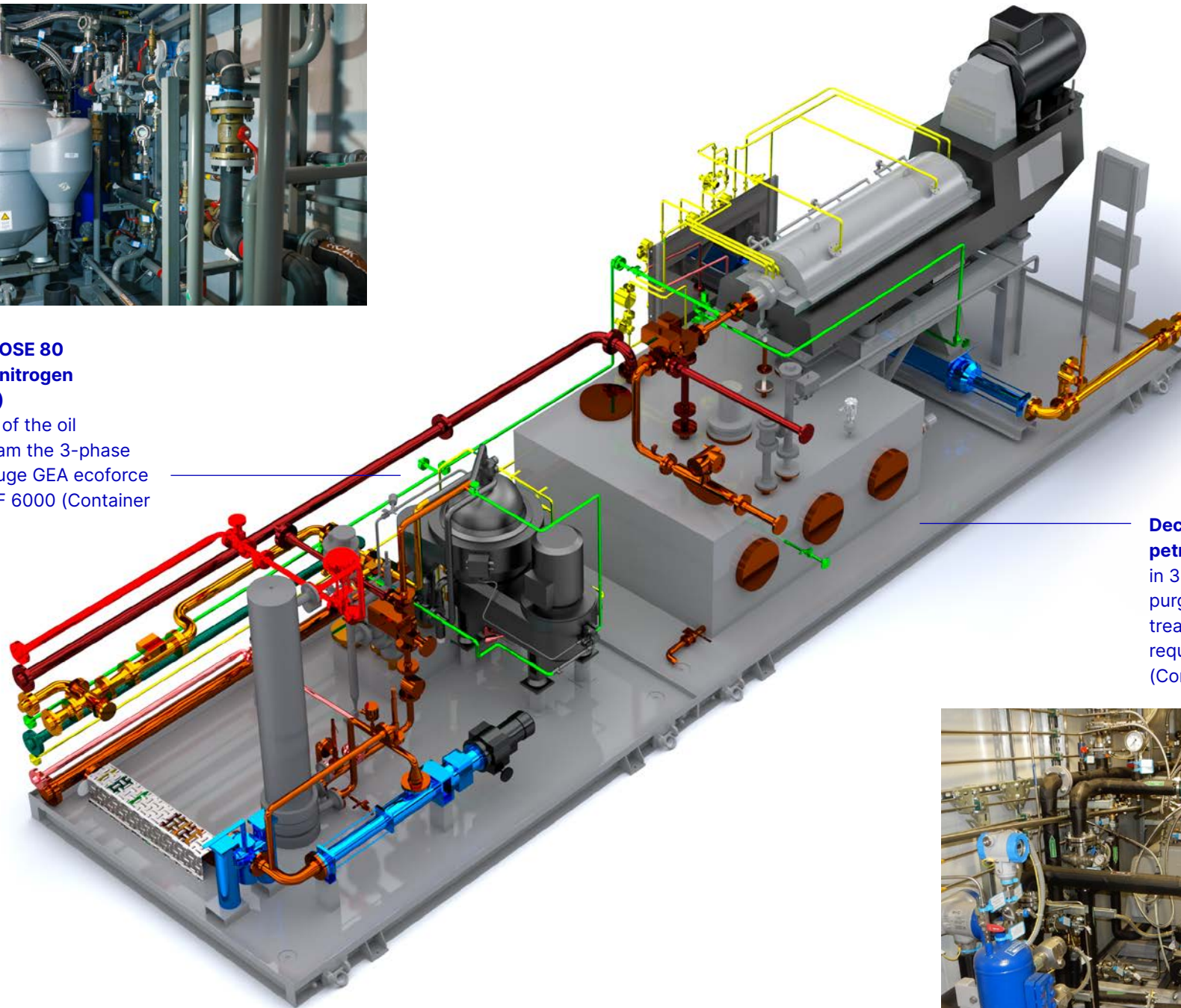
**Tailor-made solutions provided by GEA**

- Complete process solutions
- External expertise with suppliers of treatment chemicals
- One single supplier
- Long-term experience in the field and 130 years of innovations within centrifugal separation technology
- Latest, state-of-the-art technology in high-speed centrifuges providing highest g-force available on the market
- Superior reliability and availability of the treatment systems
- Reduced maintenance cost



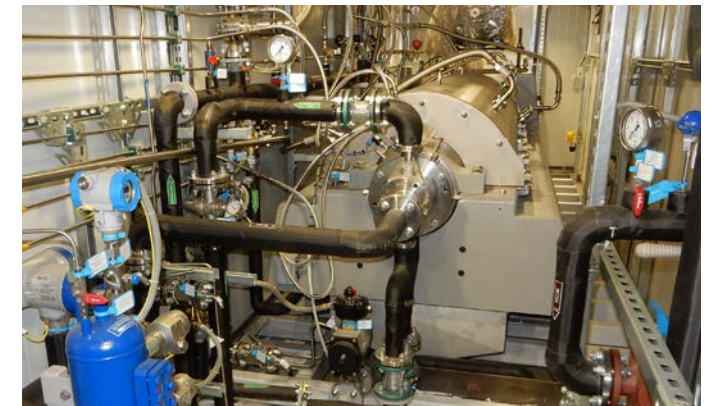
**Separator Type OSE 80  
(Ex design with nitrogen  
purging system)**

for the polishing of the oil  
phase downstream the 3-phase  
decanter centrifuge GEA ecoforce  
petroMaster OCF 6000 (Container  
installation).



**Decanter type GEA ecoforce  
petroMaster OCF 6000**

in 3-phase design with nitrogen  
purging system. Oily sludge  
treatment in the refinery. Material  
requirements according to NACE  
(Container installation).



# ENGINEERING FOR FUTURE- PROOF SEPARATION TECHNOLOGY



Speed to market – under this premise, we concentrate our experience on one objective: strengthening the value added chains of our customers with no time delay. Complete solutions from a single source minimize the time required for process integration and strengthen investment security.

The speed of implementation of new process and system developments in line with market requirements is a significant feature of GEA solutions. This is made possible by comprehensive experience and process knowledge.

GEA realizes process solutions from one supplier – with no interface problems. Technological know-how and comprehensive understanding of processes enable us to reliably solve critical issues even at the plant planning stage. As such, we can harmoniously align all process and system units to each other, from the pre-screening to classic separation solutions with separators or decanters.

## **More than merely a sum of its parts**

Only someone who can see the system as a whole can design it from the outset to provide the highest efficiency. GEA develops package units and process lines whose intelligent technology and integrated concepts immediately generate added value. This safeguards investments – and therefore an economic future.





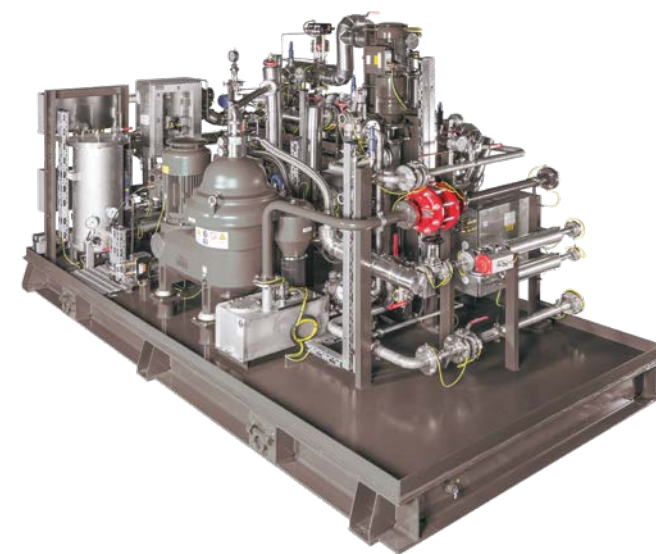
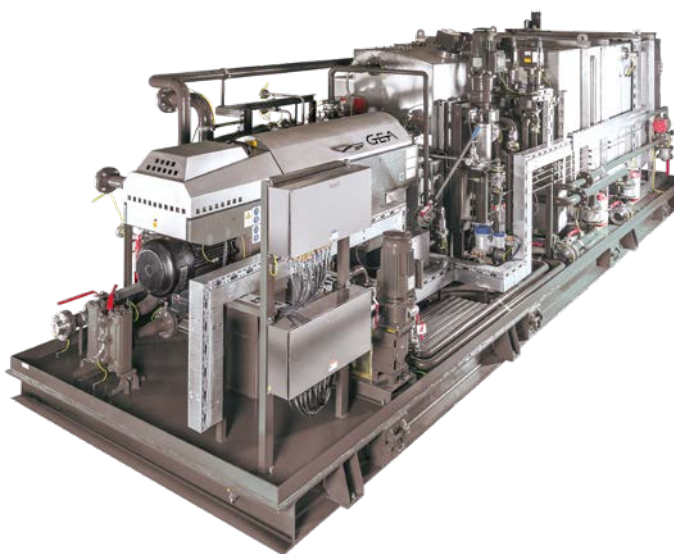
Complete solutions from one supplier eliminate time delays and expensive coordination processes right from the start. Instead, they ensure constant high performance in terms of flow rate and separation efficiency – at minimal expense. This excellent process economy secures your investment decisions in the long term.

#### Highly productive process lines from a single source:

- Competence and clear responsibility
- Reliable communication
- Reliable planning
- Optimum plant and process configuration without barriers
- High level of functionality and investment reliability
- Process safety

#### GEA scope:

- Skid-based solution
- Containerized solution
- Utilities stations and dosing units
- Heating and pumping
- Full control system
- Pre-treatment
- Hazardous area design available





# CUSTOMER-SPECIFIC SOLUTIONS

Separators and decanters are not off-the-shelf products. Rather, for optimum use, they must be selected and adjusted specifically for the process of the user. This is supported by the PTC (Process Test Center).

Customer demand / inquiry

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Sampling of product

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Product investigation / site test

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Process definition / machine sizing

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Investment estimation



### Product investigations

With the product investigations, the properties of the customer product to be separated are specified. An entire range of analysis methods are available to the PTC for this purpose, ranging from the test tube centrifuge test, rheology, corrosion pattern analysis and the measurement of various particle sizes right through to the stability characterization. The aim of the product investigations is a substantiated statement concerning the principal options for processing the product as well as the feasibility of the technical implementation. This serves to provide an initial estimate of the investment costs.

Feed stock product analysis basic parameters such as:

- Spin test with a heatable laboratory centrifuge
- Determination of viscosity and specific gravity of the oil phase
- Salt (chloride) measurement
- pH value of the water phase
- Simulation of emulsion breakers and de-emulsifiers
- Flash point and ash content measurement

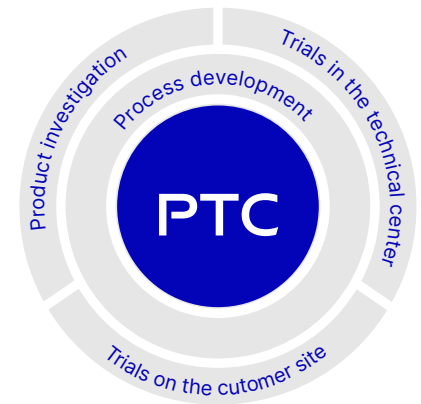


### Trials in the PTC

A technical trial provides all the important data for the final process engineering design of the production plant in which the centrifuges as well as peripheral equipment are largely operated. From this, with the close involvement of the customer, the specification of the machine type and size is determined, together with the investment costs.

### Trials on the customer site

Alternatively, the customer can be provided with a loan machine on site. In this case, the trials are supervised and assisted by experienced GEA PTC technicians.



### Process developments

The world continues to turn. New product developments stimulate demand. At the specific request of a customer or on the basis of our own market analyses, GEA's PTC supports to develop new processes. The innovative solutions we have designed in this way undergo consistent testing and checking, from laboratory testing through internal pilot trials right through to machine or prototype testing on site. Only then are they released as market-ready.





# GEA – YOUR SERVICE PARTNER



We work alongside our customers in close partnership, supporting them throughout the full life cycle of their plant and equipment to ensure lasting business success. To sustain optimum performance and ensure continued success, GEA Service provides a wide range of services to maintain and improve your plant and equipment.

## **GEA EffiClean – In-situ disk cleaning for centrifuges in mineral oil applications**

GEA has launched GEA EffiClean, an innovative solution that cleans separators' disk stacks in just 20 minutes inside the running machine. Moreover, the in-place cleaning is both environmentally and user friendly.

### **Escaping from manual disk cleaning with GEA EffiClean**

GEA EffiClean allows operators to clean disks directly where the centrifuge is located, saving precious maintenance time and optimizing the reliability, availability and efficiency of the centrifuges. Mounted on an easy-to-use trolley, the equipment combines an environmentally friendly cleaning agent and a cleaning process that reflects 130 years of experience in separation technology. Specially designed for mineral oil applications, the stainless steel unit with a footprint of only 0.5 x 0.8 m fits in narrow spaces and it's tough enough to resist the demanding environment.

## **Keep it running – fast and efficient disk cleaning in 20 minutes**

Manual cleaning of mineral oil centrifuges' disk stacks is a tedious and time-consuming process, often taking more than eight hours. GEA EffiClean cleans separators' disk stacks in just 20 minutes inside the running machine and is both environmentally and user-friendly.



**GEA Westfalia Separator Group GmbH**

Werner-Habig-Straße 1  
59302 Oelde, Germany

Tel +49 2522 77-0  
[gea.com/contact](https://gea.com/contact)