



Crude Palm Oil Processing

Separators, Decanters and Process Lines



Palm oil production worldwide: regions





GEA know-how for palm oil production

The main producer countries of palm oil are Indonesia and Malaysia in South East Asia. However, increasingly large plantations are also cultivated in South America and Africa. With its global network of sales and service activities GEA is a powerful and close partner to the palm oil industry worldwide.

Maximum performance in non-stop operation

The oil is obtained from the fruit of the oil palm, which finds optimum growing conditions in tropical countries with a constant climate. The oil is processed throughout the year in non-stop operations. The machines and process lines must be correspondingly resistant and robust. GEA supports all procedures and processes for recovering palm oil. The continuously operating technology combines extremely robust design with high product yield and excellent oil quality.

All benefits at a glance

- Flexible adjustment to all procedures and processes
- Continuous process management
- Robust technology
- Top oil quality
- Highest product yield
- Better environmental compatibility with the GEA ecod system
- Minimization of chlorine from the crude oil process



Conventional Process with Vertical Clarifier and Nozzle-Type Separator

Conventional processes for recovering crude palm oil operate with vertical clarifiers in which the oil is separated from the sludge. The oil remaining in the sludge is efficiently recovered with nozzle-type separators or 3-phase decanters from GEA.

In conventional processes, the palm fruits are desanded and pressed with the addition of dilution water. The heart of the downstream process stages are large settling tanks, so-called vertical clarifiers (VC) in which the crude oil settles out of the sludge.

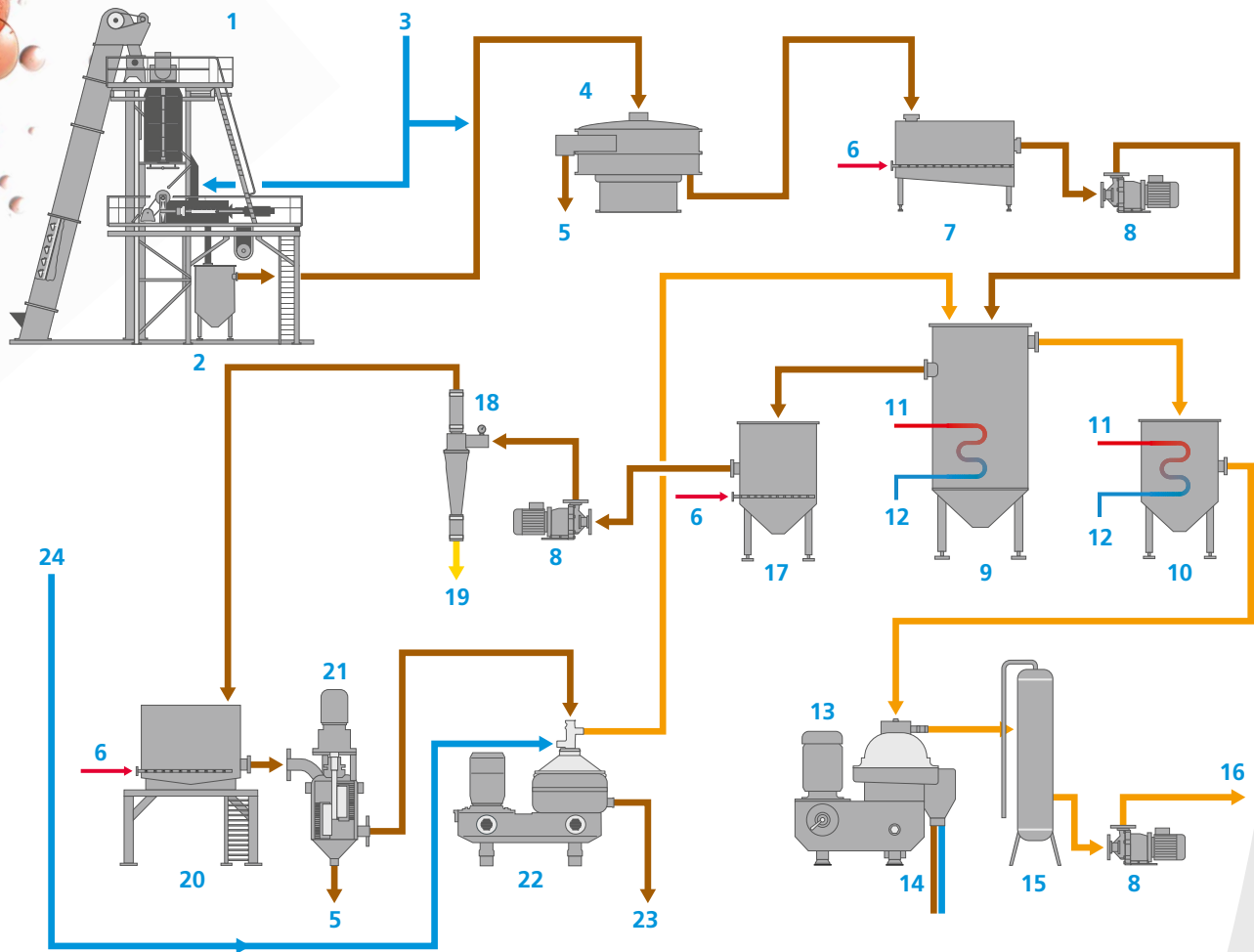
The conventional process with vertical clarifiers operates reliably, however other processes may offer more advantages in terms of oil losses, space and environmental issues.

Cost-effectiveness can be considerably improved by recovering residual oil from the settled sludge. Nozzle-type separators from GEA provide a possibility of recovering the palm oil. They separate the sludge into three phases: Palm oil, solid concentrate and water, which is recycled back into the process as dilution water.

All benefits at a glance

- Sludge deoiling in a continuous process
- Increased palm oil yield
- Reduction of the sludge to be disposed of
- Automatic CIP process
- High speed, high performance



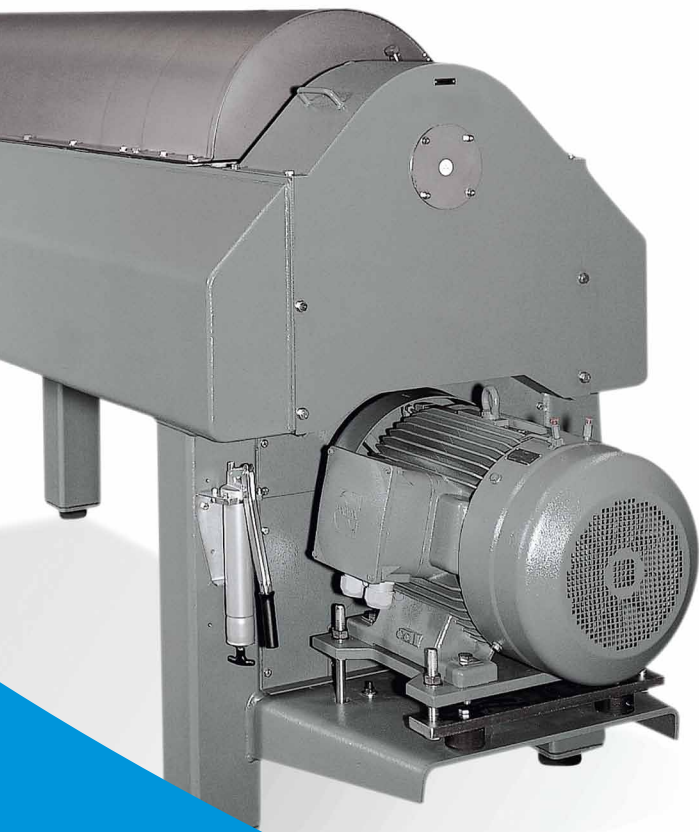


Conventional Process with Vertical Clarifier and Nozzle-Type Separator

- | | | |
|--------------------|----------------------|-----------------------------------|
| 1 Press | 9 Vertical clarifier | 17 Sludge tank |
| 2 Sand trap | 10 Oil tank | 18 Desander |
| 3 Dilution water | 11 Steam | 19 Sand |
| 4 Vibrating screen | 12 Condensate | 20 Feed tank |
| 5 Fibres | 13 Purifier | 21 Rotary brush strainer |
| 6 Live steam | 14 Sludge | 22 Nozzle separator |
| 7 Buffer tank | 15 Vacuum drier | 23 Nozzle concentrate |
| 8 Pump | 16 Oil to storage | 24 Dilution water to balance tank |

Conventional Process with Vertical Clarifier and GEA topd 3-Phase Decanter

The use of the GEA topd 3-phase decanter is an alternative to the nozzle-type separators.



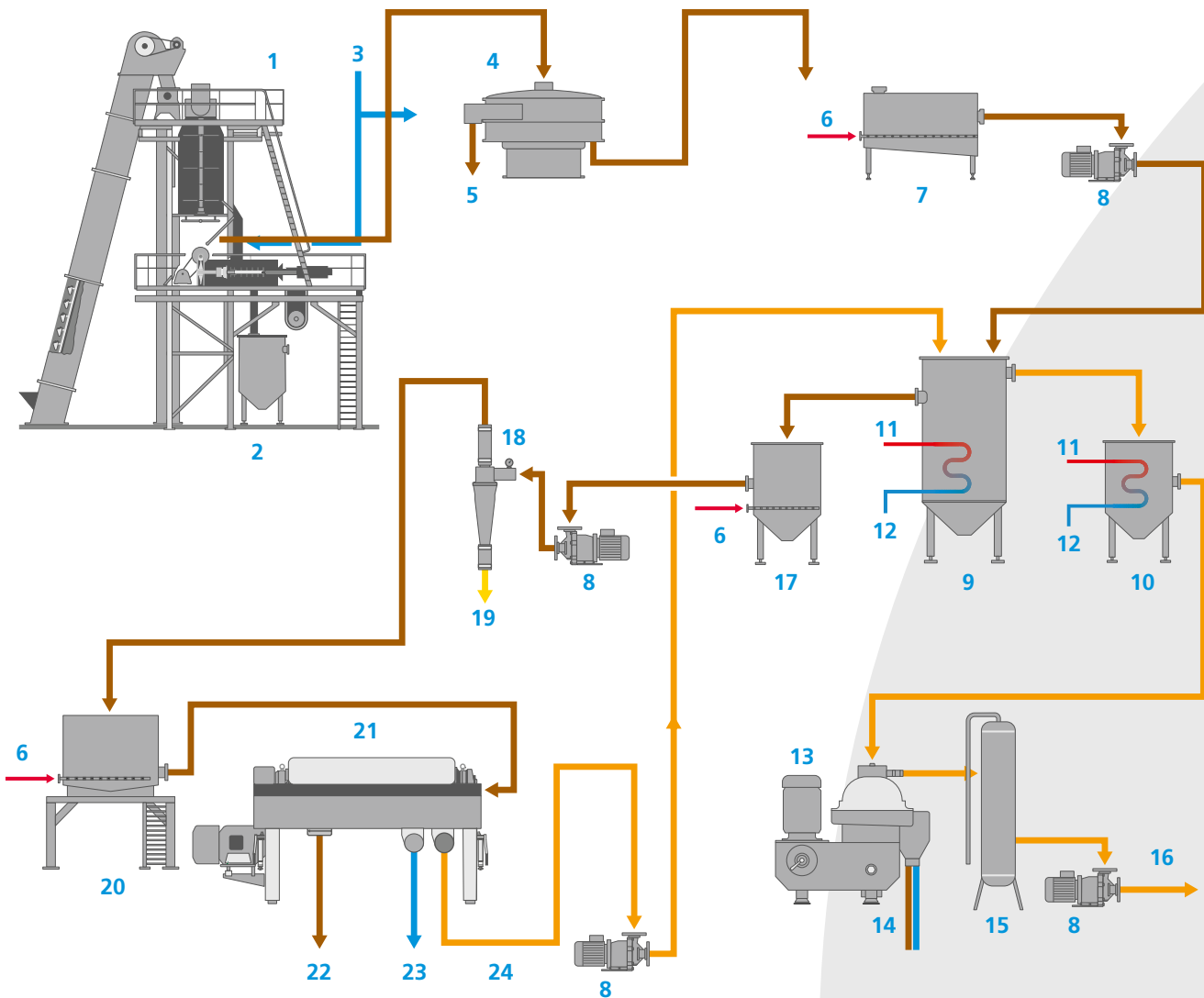
Instead of a nozzle-type separator, a topd 3-phase decanter can be used down-stream of the vertical clarifier. This 3-phase decanter combines the economic advantages of a decanter – namely high throughput capacities in a continuous process – with much drier solids.

The 3-phase decanter separates the sludge which contains oil into an oil phase, solids and virtually oil-free waste water. Because of its high dry matter, the solids can be recycled relatively easily. In addition, the solids concentration in the waste water is lower than would be the case if nozzle-type separators are used.

A further benefit of the topd decanter is the lower fresh water requirement in comparison to nozzle-type separators. In order to process the crude oil from the vertical clarifier, it is also possible to install a purifier which efficiently and reliably removes minimum contaminants from the oil.

All benefits at a glance

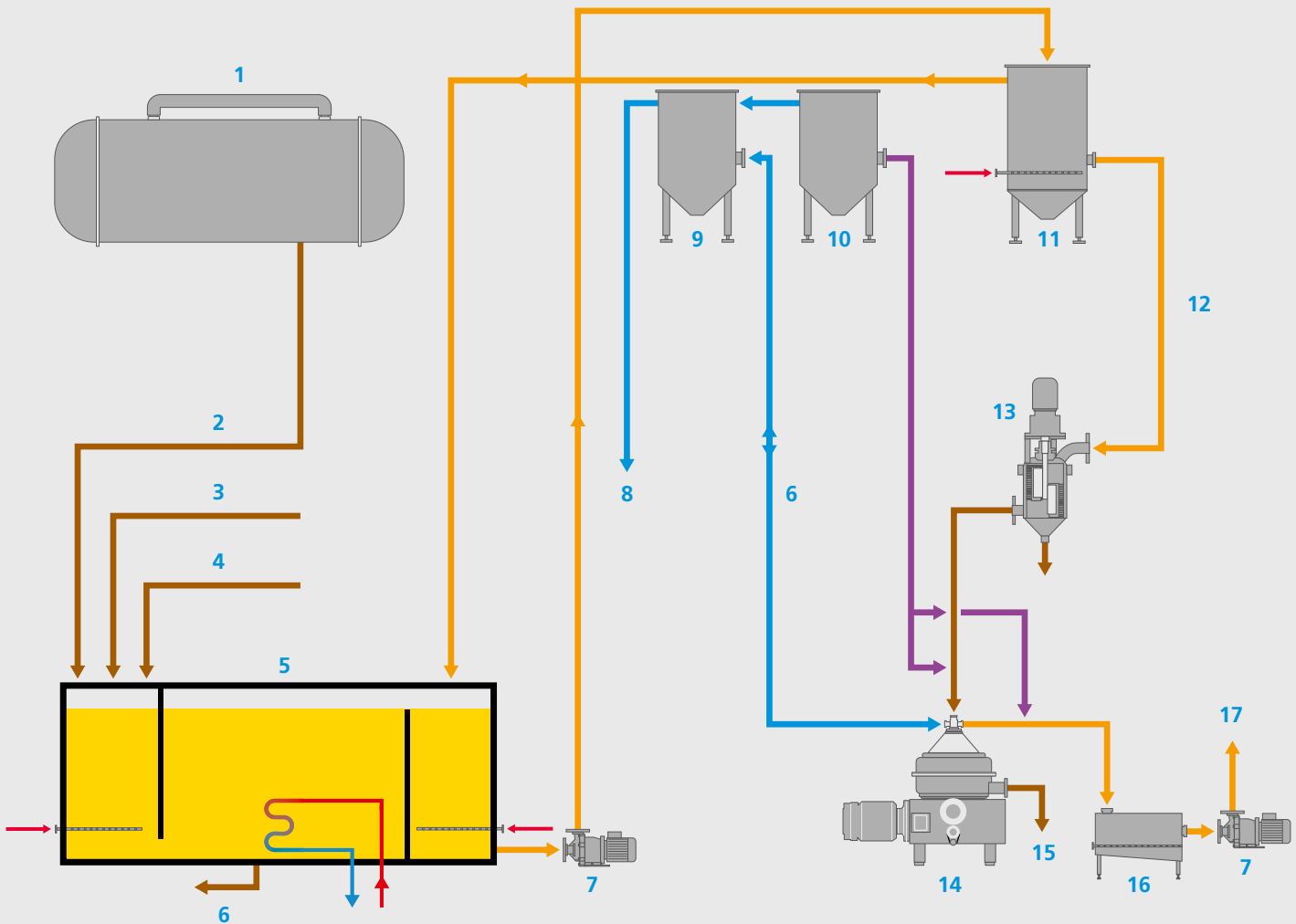
- Lower cake transportation costs due to very dry solids
- Better recovery of nutrients due to very high separation efficiency
- Lower fresh water consumption compared to other processes
- Continuous and fully automatic operation



Conventional Process with Vertical Clarifier and GEA topd 3-Phase Decanter

- | | | |
|--------------------|----------------------|----------------------------|
| 1 Press | 9 Vertical clarifier | 17 Sludge tank |
| 2 Sand trap | 10 Oil tank | 18 Desander |
| 3 Dilution water | 11 Steam | 19 Sand |
| 4 Vibrating screen | 12 Condensate | 20 Feed tank |
| 5 Fibres | 13 Purifier | 21 GEA topd decanter |
| 6 Live steam | 14 Sludge | 22 Cake |
| 7 Buffer tank | 15 Vacuum drier | 23 Waste water to effluent |
| 8 Pump | 16 Oil to storage | 24 Oil |

Oil Recovery from Sterilizer Condensate



Oil Recovery from Sterilizer Condensate

- | | | | |
|---|----------------------|------------------------|---------------------|
| 1 Sterilizer | 5 Retention tank | 10 Hot water tank | 14 Nozzle separator |
| 2 Condensate | 6 To effluent | 11 Feed tank | 15 Nozzle discharge |
| 3 Empty bunch process | 7 Pump | 12 1 % < FREE OIL < 2% | 16 Collecting tank |
| 4 Heavy phase clarification station / press | 8 To gutter | 13 Brush trainer | 17 To oil tank |
| | 9 Water balance tank | | |

The processing and recovery of oil from sterilizer condensate with separators from GEA provides additional profitability.

GEA has developed an additional process stage in order to improve the profitability of the conventional process by recovering residual oil from the sterilizer condensate.

In conventional processes with vertical clarifier, large quantities of water are generated in the processes of sterilization, pressing and processing the empty fruit bunches.

The sterilizer condensate occurs in the form of waste water which contains oil and extremely fine particles. Waste water has not been processed in the past so this process stage with a nozzle-type separator from GEA in a bypass increases the oil yield. Because of its specific design, the nozzle-type separator is able to recover the palm oil which is contained in the sterilizer condensate. The recovered oil can be used to produce biofuels. The volume of waste water is also considerably reduced.

All benefits at a glance

- Continuous process stage in a bypass arrangement
- Increased overall oil yield, suitable for biofuel production or oleochemical processes
- Reduced volume of waste water
- CIP not necessary
- High speeds, high performance



Crude Oil Process with GEA topd 3-Phase Decanters

The crude oil process with 3-phase decanters does not need vertical clarifiers and sludge tanks.

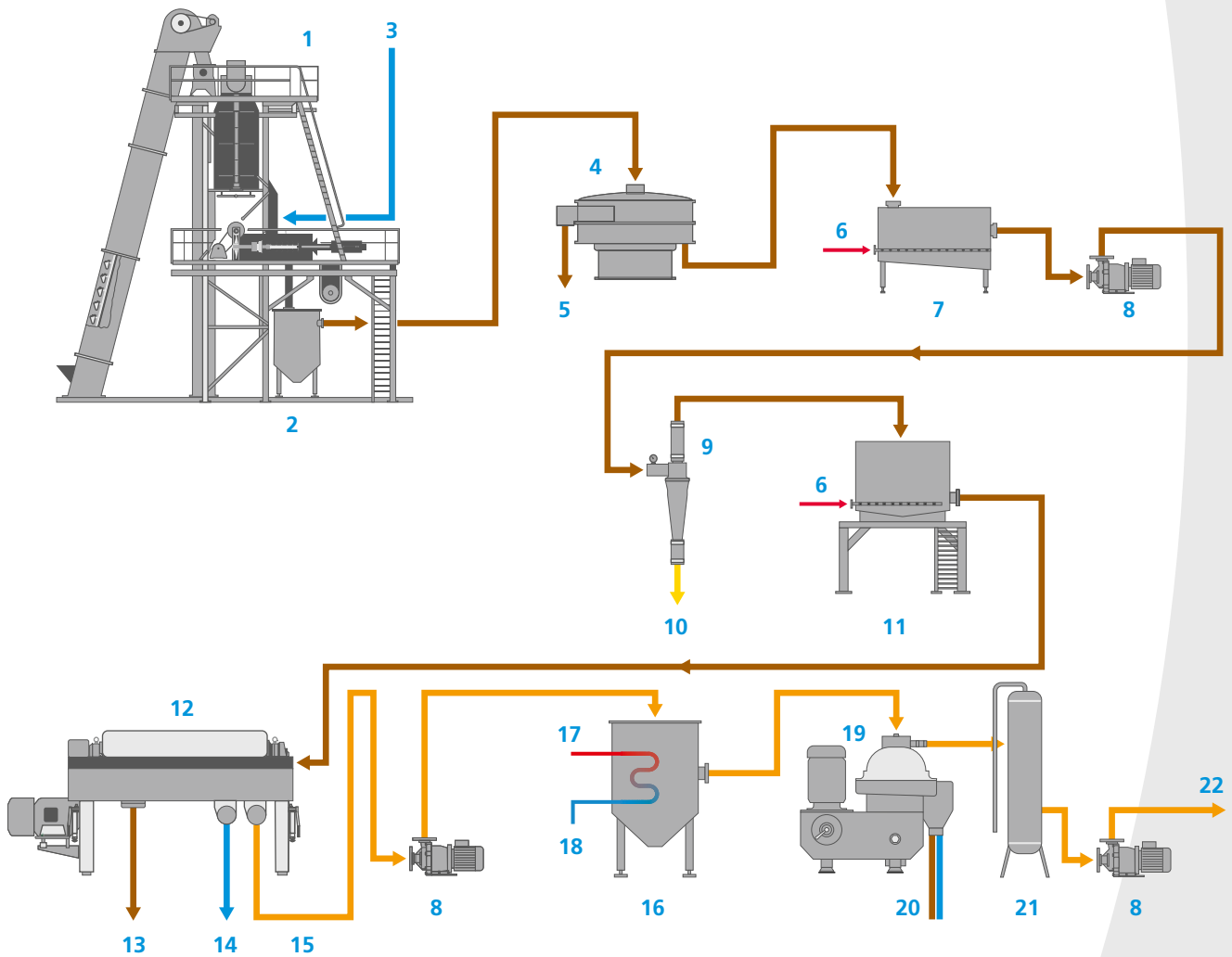
The pressed and de-sanded palm oil in this process is sent directly to the topd 3-phase decanter. The main advantage is to be seen in a much shorter process time and lower oil losses. The risk of oxidation of the crude oil is also less significant compared to the process using vertical clarifiers. Because the large-volume tanks are not necessary, the dimensions of the process lines can be much smaller. Due to lower dilution water requirements, valuable fresh water is saved.

The 3-phase decanter separates the pressed crude oil mixture into an oil phase, a dry solids cake and virtually oil-free waste water. The oil phase is sent to a purifier, which polishes the palm oil and reliably removes even extremely small contaminants.

All benefits at a glance

- Shorter process time
- Minimum space requirement
- Lower fresh water requirement
- Higher oil yield
- Lower oxidation risk
- Lower volume of waste water compared to the conventional process
- Continuous and fully automatic operation





Crude Oil Process with GEA topd 3 Phase Decanters

- | | | |
|--------------------|----------------------------|-------------------|
| 1 Press | 9 Desander | 17 Steam |
| 2 Sand trap | 10 Sand | 18 Condensate |
| 3 Dilution water | 11 Feed tank | 19 Purifier |
| 4 Vibrating screen | 12 GEA topd decanter | 20 Sludge |
| 5 Fibres | 13 Cake | 21 Vacuum drier |
| 6 Live steam | 14 Waste water to effluent | 22 Oil to storage |
| 7 Buffer tank | 15 Oil | |
| 8 Pump | 16 Reheating tank | |

GEA ecod System – with 2-Phase Decanters



With the ecod system for the crude oil process, GEA has developed the most innovative process currently available on the market.

The GEA ecod system combines extremely short process times and significant environmental compatibility with excellent product quality as well as a significant reduction in oil losses and fresh water requirement. The system needs only a minimum of dilution water. Vertical clarifier and sludge tank are not necessary. In this way, the process time is considerably reduced, and the energy consumption is also lower. The amount of effluent is reduced to less than 25 % in relation to the volume of processed fruits. This is nearly half the quantity created in the conventional process.

In conventional processes, huge ponds are necessary in order to handle the effluent which is very organically contaminated. These ponds release large quantities of the greenhouse gas methane, which is more than 20 times more problematical for the climate than carbon dioxide. The GEA ecod system considerably reduces the methane problem because the ponds are much smaller. The formation of methane is reduced to such an extent that the palm oil millers are able to sell CO₂ certificates via emission rights trading and are thus able to generate additional profit.

The three main components of the system are an automatic de-sanding system (multicyclone), a special ecod decanter as well as a high-performance purifier. The decanter system generates two phases from the crude oil: Clean oil and an NOS/fruit water mix, which contains almost 100 % of the nutrients.

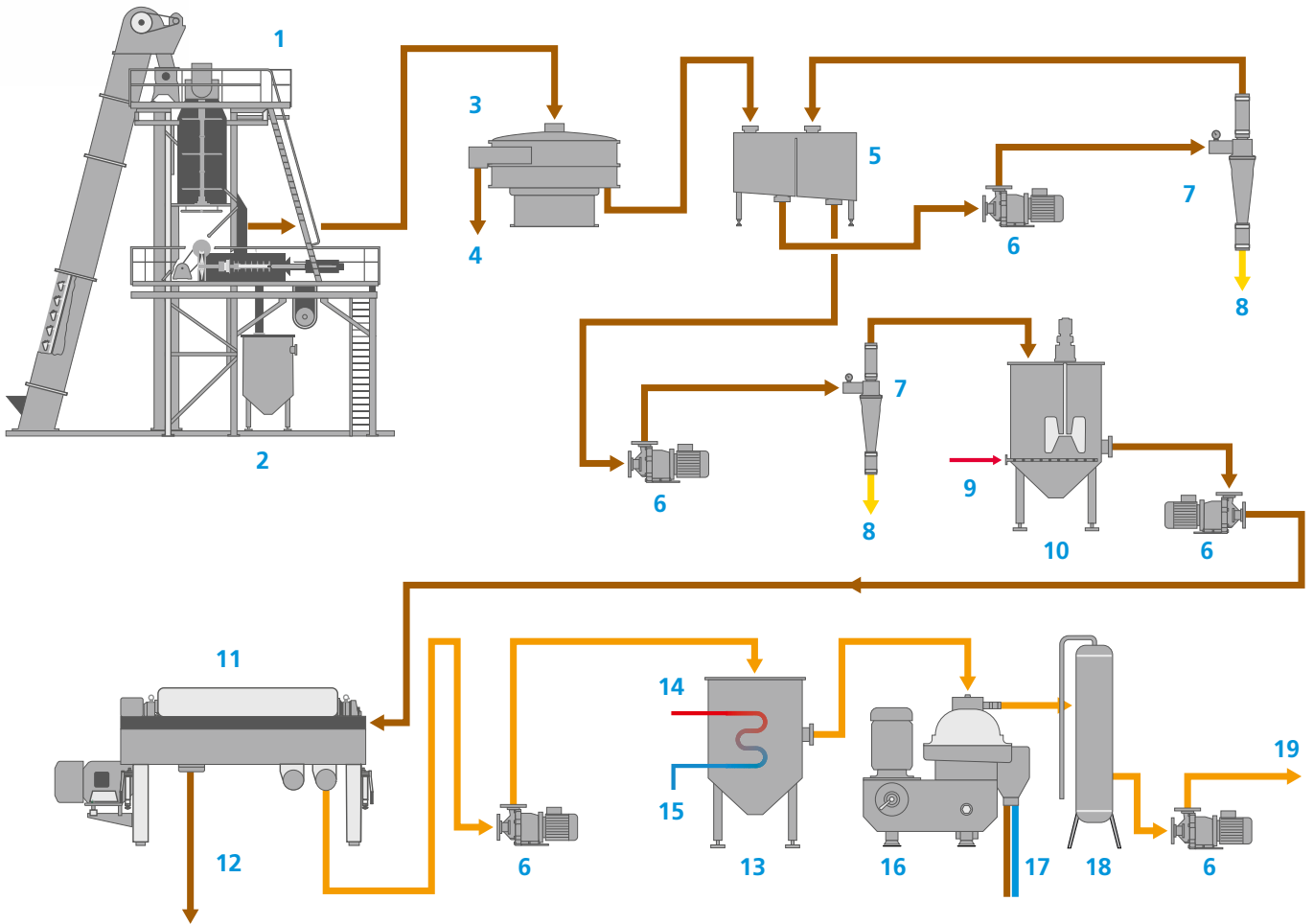
A separate waste water phase that is created in the conventional process, is eliminated. As a result of the special rotor design, the highly viscous crude oil can be separated in one process stage with almost no dilution water.

In the GEA ecod system waste water is only created in the up-stream sterilization stage. If required, this can be purified with the aid of nozzle-type separators or it can be used for the composting process.

The oil which is recovered in this way is sent via a heating tank to the self-cleaning separator, which removes the remaining solids entirely from the palm oil. The oil is then dehydrated in a vacuum drier and put into storage. The slurry can be mixed with the empty fruit bunches and be composted. If the palm oil mill has a demand or a market for biogas/energy, the POME (sterilizer condensate and decanter biomass) can be treated in a biogas plant. For this kind of POME with high dry matter content totally mixed digesters are necessary. The mass is turned on several occasions whereby the water is evaporated, resulting in a valuable fertilizer which can be used for the plantation or for selling.

All benefits at a glance

- Simplified process with high environmental compatibility for sustainable production
- Extremely short process time
- Virtually no dilution water
- Low energy consumption
- No vertical clarifier and sludge tanks
- Much smaller ponds – considerably reduced methane formation
- Higher product yield
- Palm oil in premium quality
- Recycling of nutrients
- Increased ffb production by organic fertilizer
- Most appropriate process setup to produce CPO with minimum ffa and chlorine content



GEA ecod System – with 2-Phase Decaners

- | | | |
|--------------------|---|-------------------|
| 1 Press | 8 Sand | 14 Steam |
| 2 Sand trap | 9 Live steam | 15 Condensate |
| 3 Vibrating screen | 10 Feed tank | 16 Purifier |
| 4 Fibres | 11 GEA ecod decanter | 17 Sludge |
| 5 Buffer tank | 12 To biogas production and/or composting | 18 Vacuum Drier |
| 6 Pump | | 19 Oil to storage |

GEA ecod Decanter

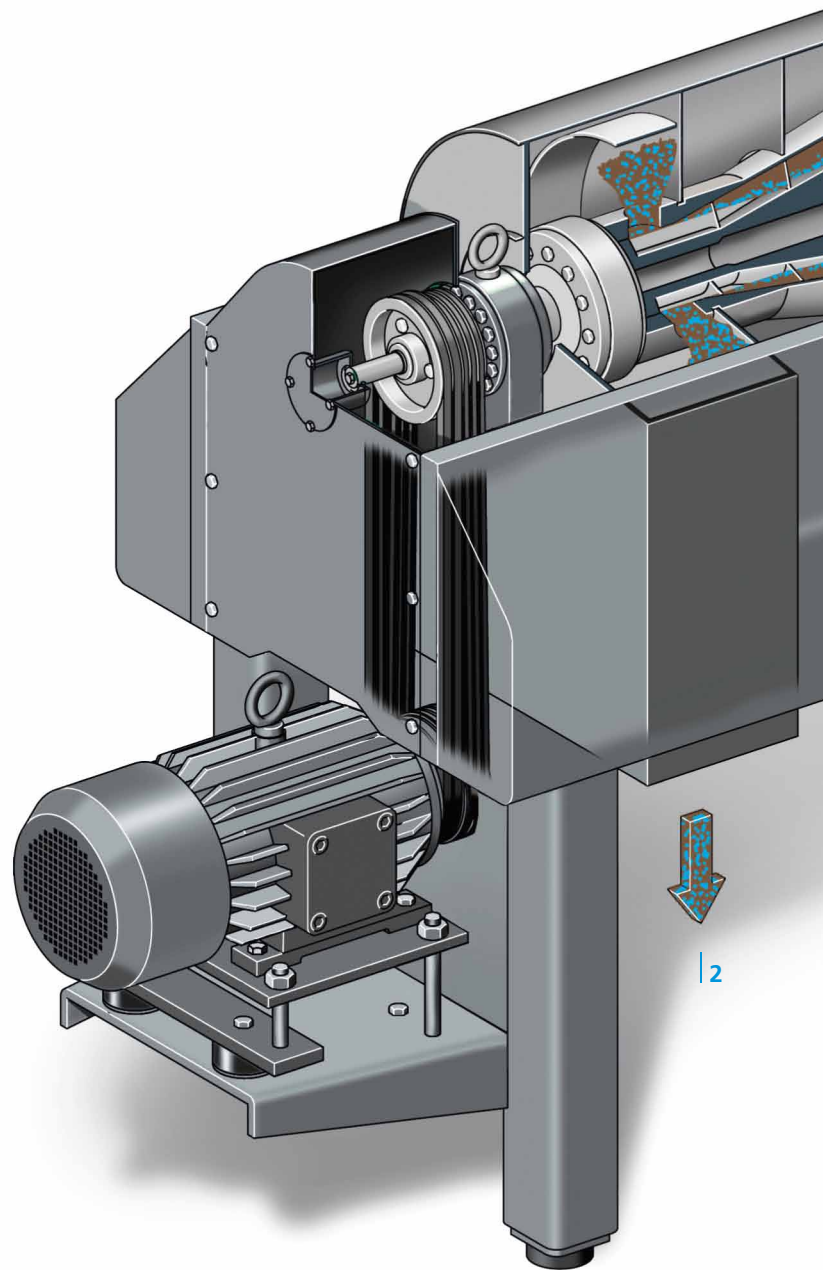
With the special rotor design of the GEA ecod decanter palm oil can be recovered with a minimum of dilution water.

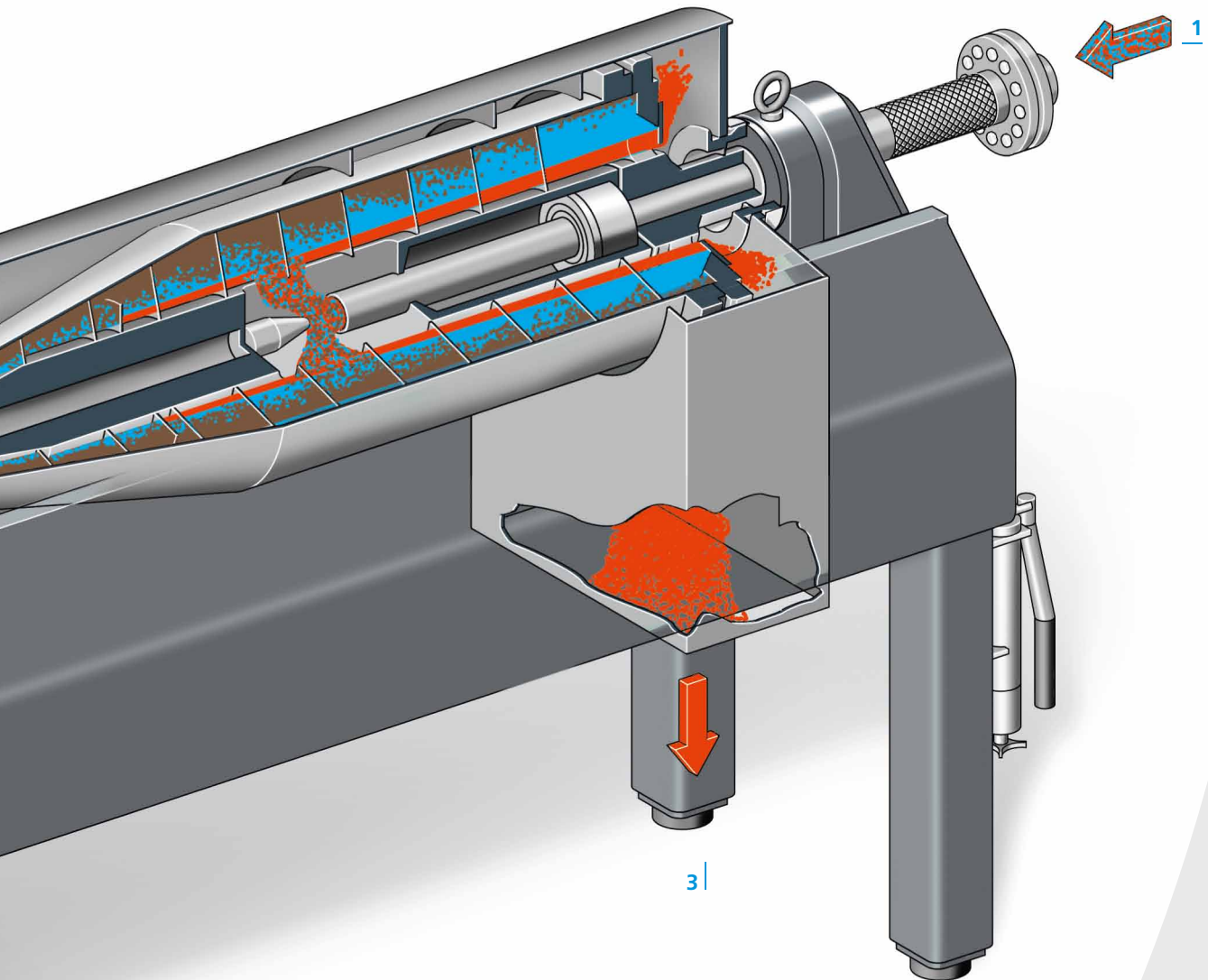
In the production of palm oil, decanters form the heart of every modern process line. The decanters from GEA feature the know how gained in 120 years of experience in the development of centrifuges. In addition to the increased product yield, producers of palm oil particularly appreciate the robust design of the decanters, which is particularly important in intensive and hot non-stop operations. High product reliability and maximum availability make the decanters of the technology leader in centrifugal separation technology the international first choice.

The GEA ecod decanter is one of the most efficient developments in this respect. The special rotor of this innovative 2-phase separating decanter can process the highly viscous crude oil in a single process stage. Model versions are available for processing up to 35 tonnes FFB per hour.

All benefits at a glance

- Robust quality
- High process reliability – maximum availability
- Simple operation and control
- High efficiency – excellent ROI
- Maximum product yield





- 1 Feed
- 2 Water and solids
- 3 Palm oil

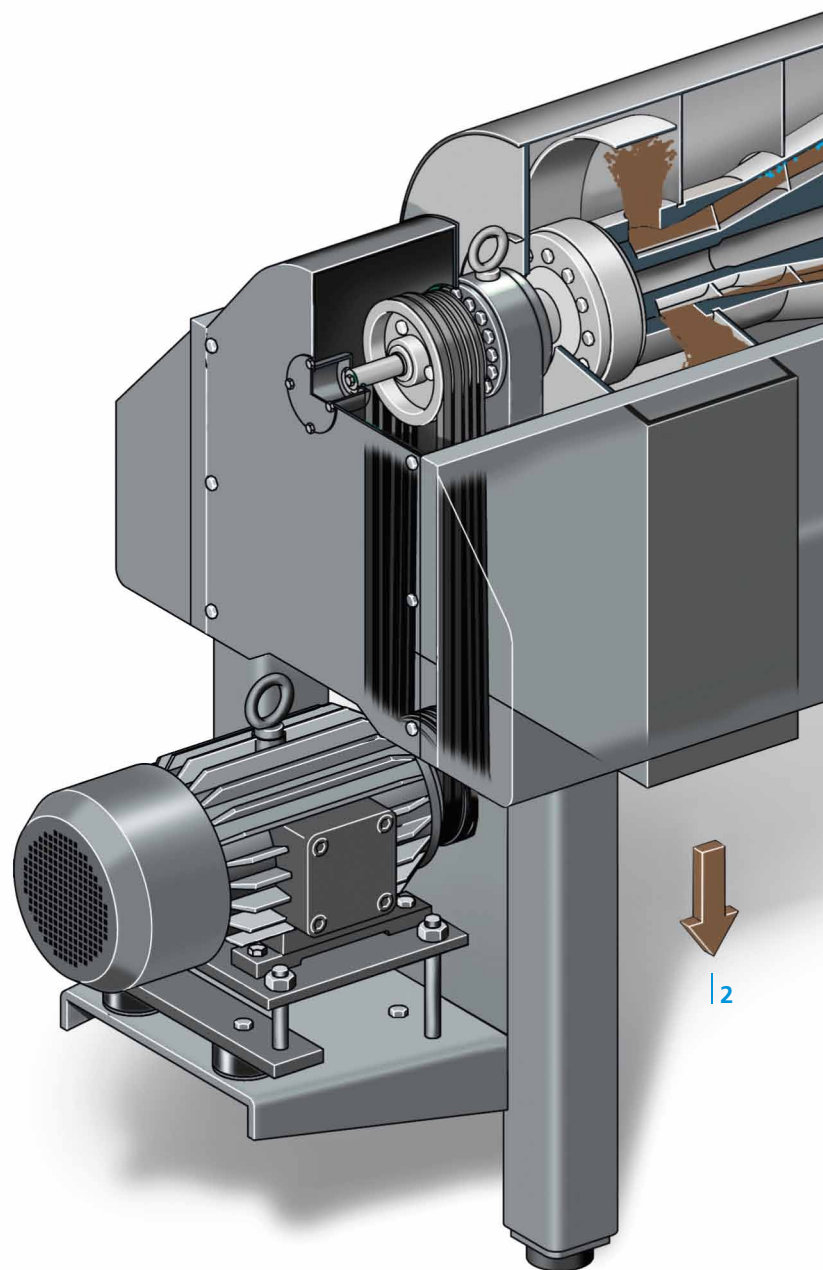
GEA topd 3-Phase Decanter

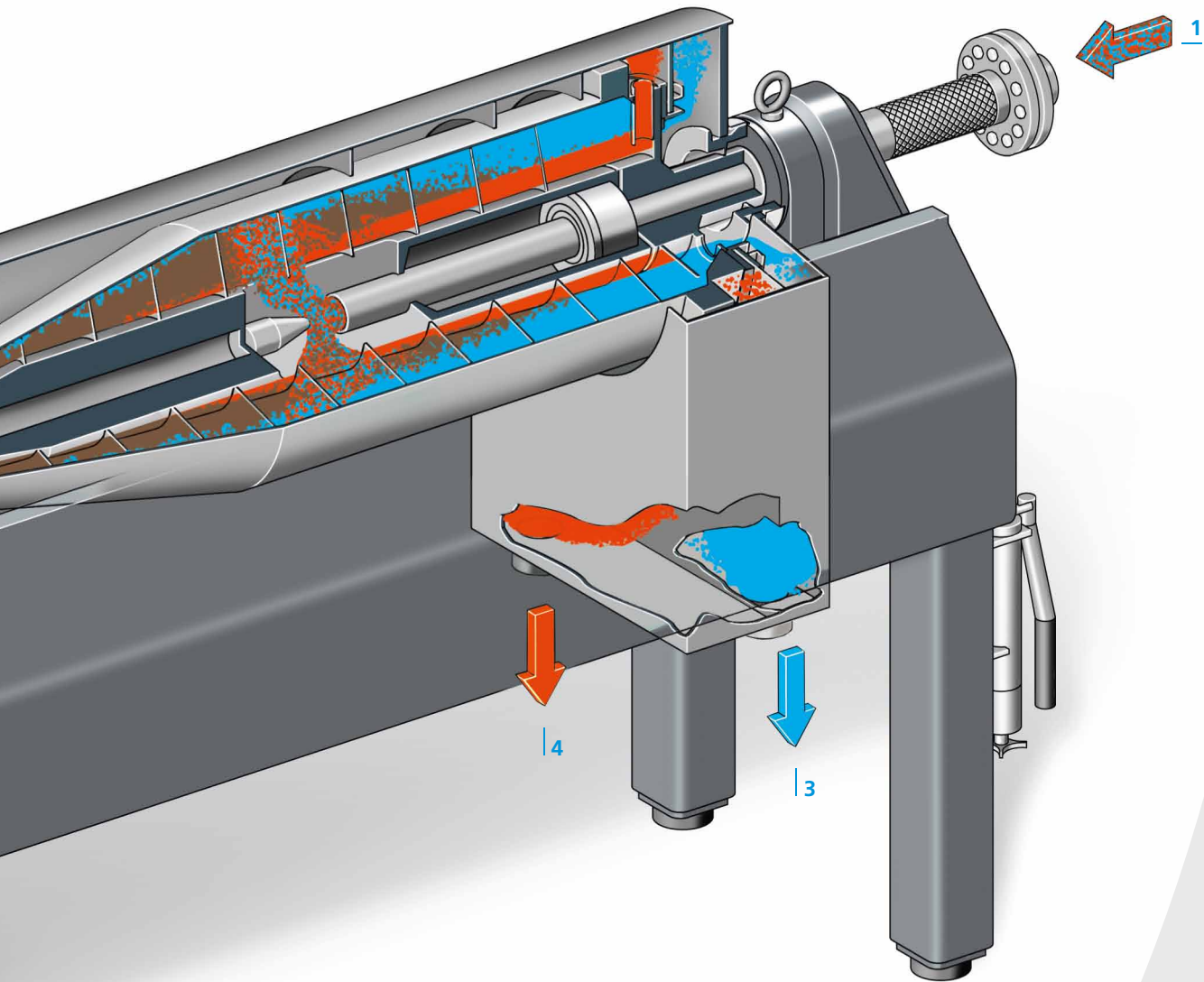
In the conventional process with a vertical clarifier or in the crude oil process, the topd 3-phase decanter provides efficient and cost-effective operation.

The topd 3-phase decanter separates the liquid-liquid-solids mixture into an oil phase, solids and waste water. This decanter series is designed for maximum separation efficiency and is equipped with an exceptionally long and slender rotor system. This enables high throughput capacities to be achieved in a continuous process, as required in non-stop operations for recovering palm oil. The topd 3-phase decanter also produces solids with a dry matter which is very high compared with conventional 3-phase decanters. The solids can thus be easily disposed of. Moreover, there are considerably lower volumes of solids in the waste water. Because the fresh water requirement in this development has also been reduced, the topd 3-phase decanter supports an economic operation which makes efficient use of resources.

All benefits at a glance

- Low oil losses
- Very dry solids
- Robust quality
- High product reliability – maximum availability
- Simple operation and control
- High efficiency – excellent ROI
- Maximum product yield





- 1 Feed
- 2 Solids
- 3 Water
- 4 Palm oil

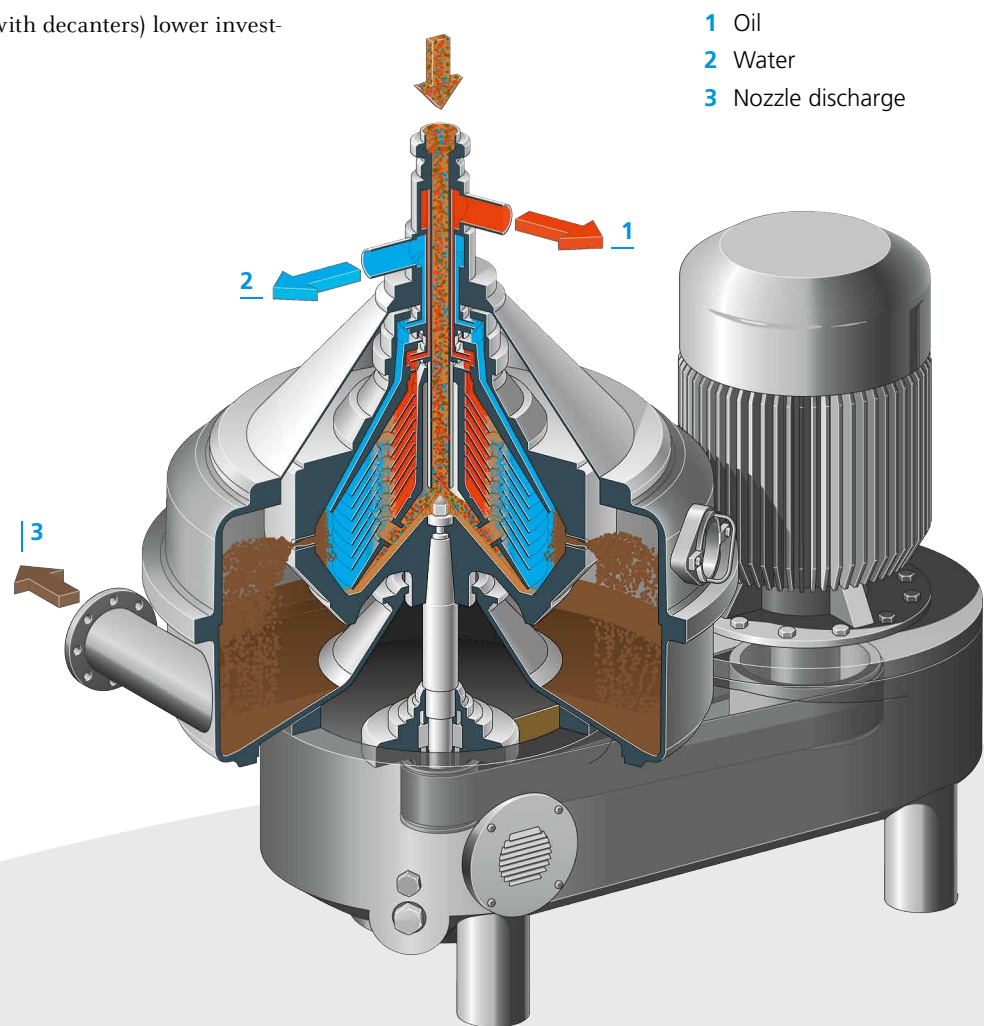
High-Speed Nozzle-Type Separators

An economic alternative in the conventional process with a vertical clarifier

The task of the nozzle-type separator is to continuously recover palm oil from the sludge which contains oil and which is fed to the separator from the vertical clarifier. These nozzle-type separators feature high throughput capacities, a very robust design, low space requirement, a high degree of automation and (compared with decanters) lower investment costs.

All benefits at a glance

- Continuous operating mode
- Automatic operation
- Low manpower requirement
- Low space requirement
- High speed – high efficiency



Purifier VSE Series

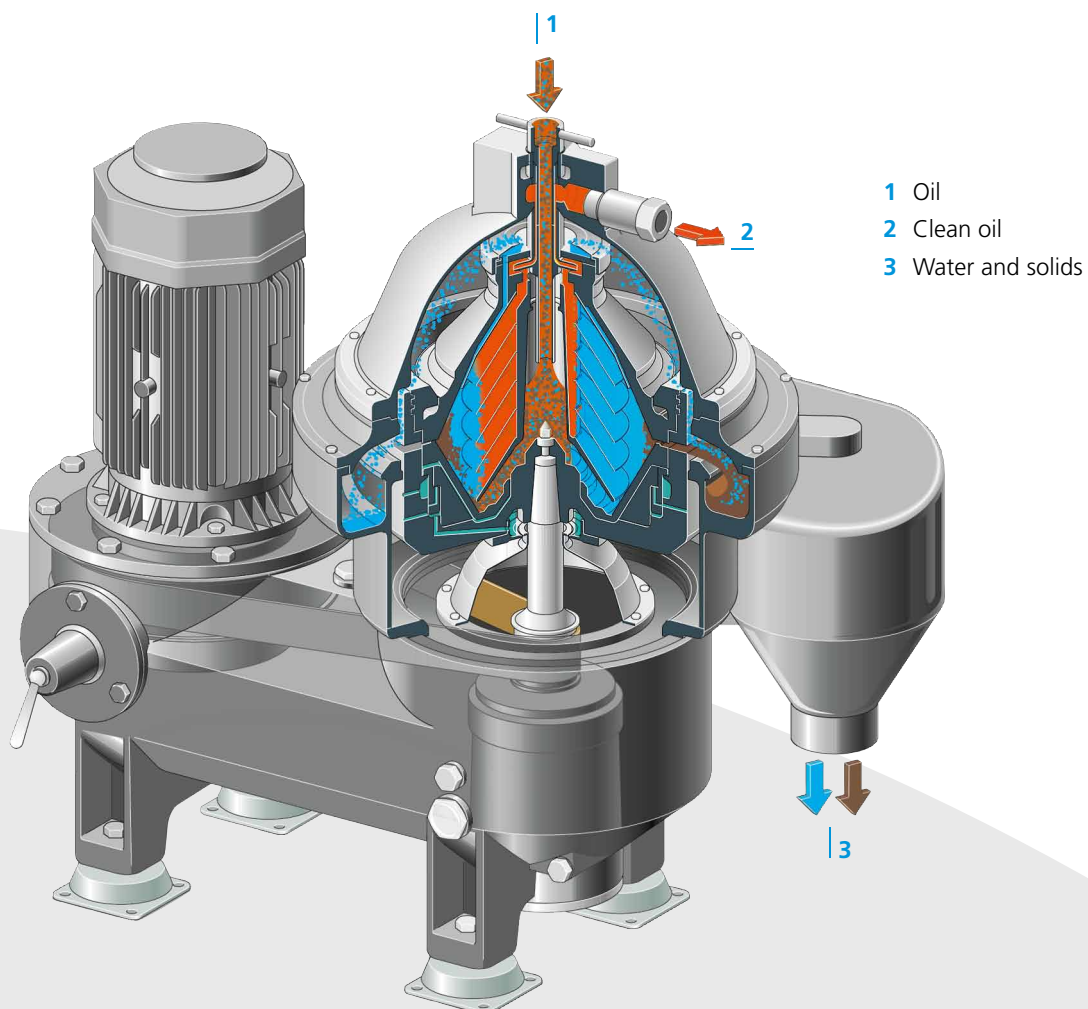
Purifiers from GEA assure premium quality of CPO by removing all residues in conjunction with extremely gentle product treatment.

In order to recover extremely pure palm oil, special purifiers are installed downstream of the decanter stage. The purifiers of the VSE series are ideal for this particular task. Because of their high separating efficiency, they separate all undesirable solids reliably and efficiently from the palm oil. All models in the VSE series are state-of-the-art.

The self-cleaning purifiers reduce the amount of maintenance to a minimum, provide extremely gentle treatment for the oil and, with the GEA hydrostop system, ensure optimum product yield. With this system, the partial discharges can be adjusted so precisely that the liquid is retained in the bowl when solids are ejected, thus avoiding product losses.

All benefits at a glance

- GEA hydrostop system for higher product yield
- Self-cleaning
- Improved clutch design – for a longer wear lifespan
- All components which come into contact with product are made of stainless steel
- Flat-belt drive for low maintenance
- Higher g-force
- Automated operation
- Continuous processing mode
- Simple maintenance
- Low-noise design



Auxiliary Equipment

Multicyclone systems, rotary brush strainers and vacuum driers complete the product range.

The components presented at this point turn the range of decanters and separators from GEA into complete process lines.

Multicyclone systems

The crude oil has to be desanded before it is fed into the centrifuges so that erosion problems which are caused by the sand can be avoided.

This stage is handled in a simple and reliable manner with the fully automatic multicyclone systems from GEA. All components which come into contact with product are made from wear resistant materials, and are thus extremely robust.

All benefits at a glance

- Fully automatic principle of operation
- Optimum sand separation with uniform feed conditions
- Components which come into contact with product are made from wear resistant materials
- Available in many automatic configurations



Rotary brush strainers

The use of upstream rotary brush strainers is recommended whenever nozzle-type separators are used, in order to prevent the nozzles from becoming clogged with coarse particles.

All benefits at a glance

- Conditions the suspension to facilitate discharge through nozzles
- Automatic self-cleaning

Vacuum driers

The palm oil which is recovered is dehydrated in a final process stage. For this purpose, GEA provides various vacuum driers which meet all requirements in terms of efficiency and effectiveness.

All benefits at a glance

- Automatic and continuous principle of operation
- Optimum evaporation of residual humidity in the palm oil
- No oxidation
- Short process time
- Low energy requirement



GEA Service – For your continued success

Improve the life cycle cost of your plant and equipment.

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.

Getting you started

We start as we mean to go on, a supportive and committed partner for life. We plan and build around individual needs, sharing process knowledge, training employees and supporting operators to get our customers up and running and ensure a smooth, seamless on-going service.

Keeping it running

To ensure our customers benefit from continuous production processes for minimal unexpected downtime, we provide fast support, efficient maintenance and top-quality spare parts, whenever and wherever needed.

Constantly improving

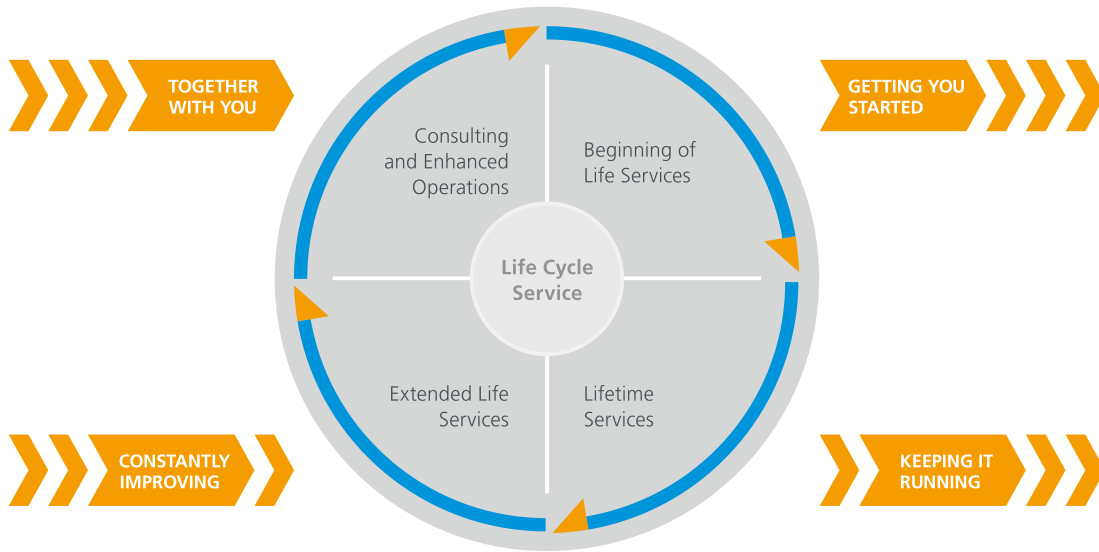
We safeguard our customers' investments by constantly looking ahead through modernizing or upgrading of equipment and optimizing of processes to meet changing needs and new market demands. We are always working to increase production efficiency and ensure peak performance.

Together with you

Commitment to our customers and their business means investing in their objectives, their risks and their future success. We work in ever-closer collaboration, providing on-going systems audits and on-site support through innovative new service models in order to generate improved performance.



Our four stages of continued success



GEA Service – For your continued success





We live our values.

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA is a global technology company with multi-billion euro sales operations in more than 50 countries. Founded in 1881 the company is one of the largest providers of innovative equipment and process technology. GEA is listed in the STOXX® Europe 600 Index. In addition, the company is included in selected MSCI Global Sustainability Indexes.

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