



GEA centrifuges for metallurgy

Crud treatment, PLS clarification and recovery of organic components

$$(6 \cdot 1) \cdot 5 \cdot (5) \cdot W \cdot \frac{\pi}{15} = A$$

$$\frac{1 \cdot V \cdot 0.81}{\Delta} \sqrt{\quad} = \text{rep}$$

INVESTMENT SECURITY

right from the very beginning: in addition to crud treatment and PLS clarification in the extraction of base metals, GEA also has skills in the processing of bulk mining products.

Reliable

The comprehensive GEA know-how in the design, production and process integration of centrifuges is essential for optimum results in the recovery of base metals.

Whether crud treatment, PLS clarification or recovery of organic components: GEA centrifuges, systems and process lines set standards for performance, service life as well as for economic and environmentally reliable operation.

Plan your success

Thanks to the many years of experience and continuous investments in research and development, the company offers its customers a crucial technological edge. The GEA global network of test centers is available for complex trials in order to create a reliable decision-making basis for investments.

From initial advice, basic and detailed engineering right through to the commissioning of the installations, GEA offers a perfect combination of process knowledge, sound knowledge in plant construction, first-class products and technologies. The result is reliable process management with maximum availability of the centrifuges which are used.

Whatever objectives are relevant: the solutions from GEA mean that success can be planned. Agreed performances are attained reliably and permanently.

Benefits at a glance:

- Optimum process results
- Permanently reduced production costs
- Maximized production capacities
- Protection of people and environment

Stable process conditions due to centrifuges

Separators and decanters from GEA ensure better efficiency for the liquid extraction of base metals.

Metals such as copper, nickel and zinc are extremely important commodities. Liquid extraction with acid has become established as the standard method for recovering such metals. However, the formation of crud in the settling tanks is a problem; crud is an emulsion layer comprising aqueous and organic components, air and solids. The fact that the emulsion remains stable under normal conditions of gravity deteriorates the extraction process substantially. Therefore the emulsion has to be removed continuously from the recovery process or must be prevented.

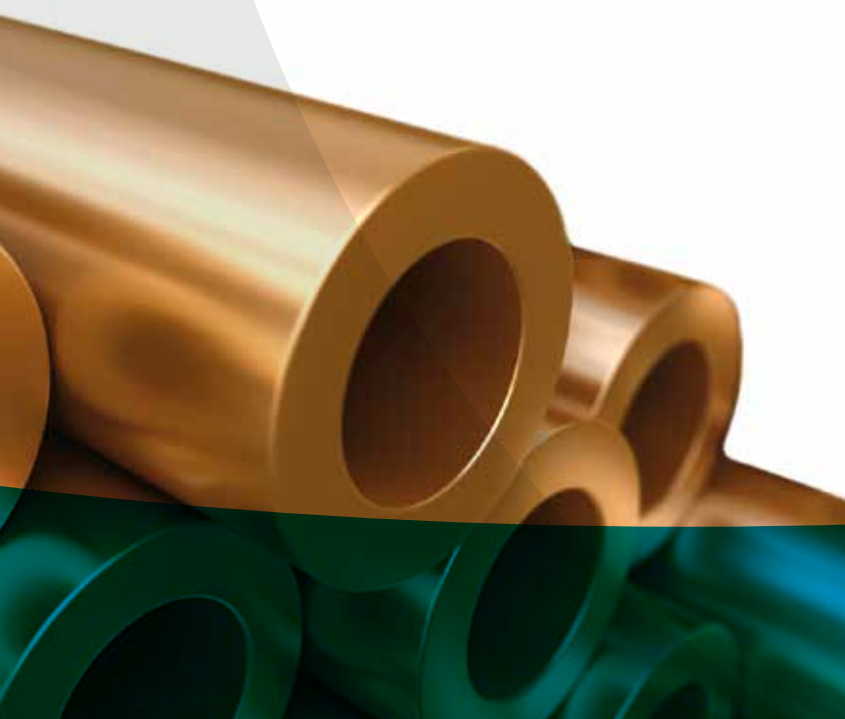
For removing the crud in the extraction stage, GEA 3-phase decanters specially designed for the tough requirements of the product are the first choice. In an initial stage, these decanters separate the emulsion which has previously been drawn off from the tank into solids, aqueous phase

and solvent. Water and solids are disposed of. The organic phase, however, is enriched with activated clay and is then passed through a 2-phase decanter.

In doing so, the pure solvent may be recovered and recycled with the extraction stage without harming the efficiency of the process.

The use of centrifuges provides two essential benefits

Firstly, large quantities of solvent are recovered, saving costs and protecting the environment. Secondly, crud formation is minimized due to its continuous removal. This is the only way to achieve constant efficiency in the extraction stage and thus stable process management with maximum results.



PLS clarification – the most innovative alternative

PLS clarification with nozzle-type separators from GEA goes one step further: it does not permit crud to form.

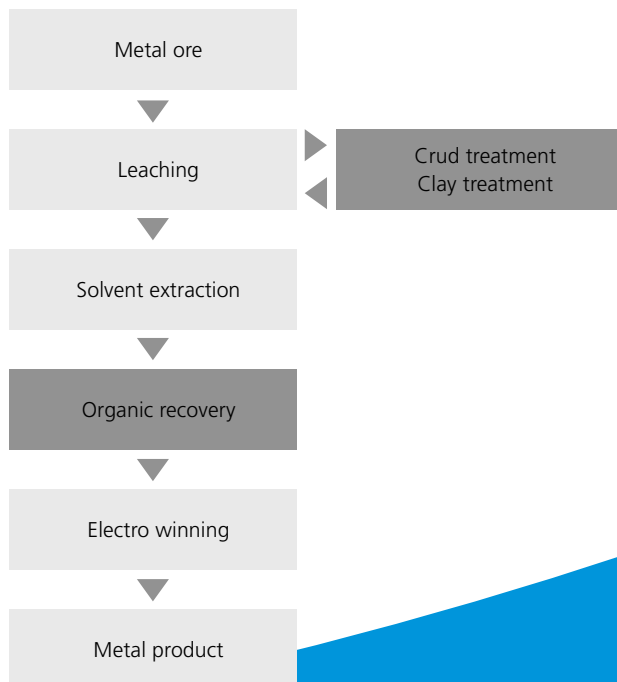
In addition to the traditional crud and clay treatment with decanters, GEA also offers an alternative process: PLS clarification with special nozzle-type separators. Here, impurities leading to crud formation are removed from the process so early that crud is completely avoided.

PLS clarification takes place between the organic washing and extraction stage. The PLS (Pure Liquid Solution) from leaching contains insoluble solids such as mica or clay which form the crud.

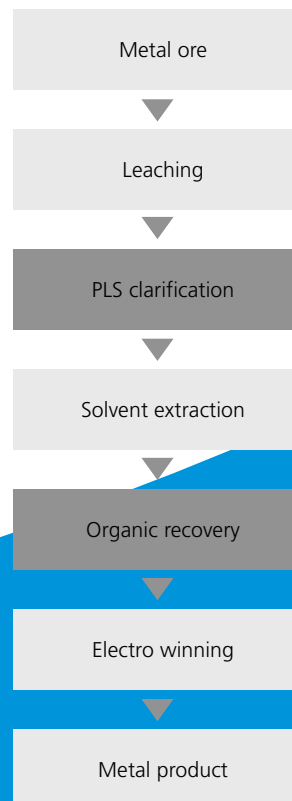
Nozzle-type separators from GEA reliably remove those insoluble particles. Those particles which are too large for the nozzle-type separator are removed in an upstream rotary brush strainer. In this simple and intelligent manner, crud is prevented before it occurs.

Additionally, the electrolyte bath can be used for a longer period when using the GEA high-performance separator to remove the aqueous phase and a small percentage of solvent before the electrolysis.

Crud treatment / Clay treatment



Pure Liquid Solution (PLS) Clarification



More than just a centrifuge

GEA offers a comprehensive range of services to the base metals industry.

GEA supports its customers in crud treatment and PLS clarification from the initial product test in the decision-making process right through to 24-hour service after the centrifuges have been installed.

Together with the GEA test center, product tests are carried out to determine how the product can be separated most effectively and what materials which come into contact with product have to be used. In addition, initial recommendations are also provided with regard to the design of the process, and cost estimates are made. The

optimum process design is developed by the process experts in close cooperation with the customer.

Thus, GEA project management offers all services from a single source – from the individual installation layout right through to the commissioning of the installations and comprehensive service options. The involvement of all parties and resources means that it is always possible for customer requirements to be met, and in many cases even exceeded, in terms of cost and production efficiency.

Benefits at a glance:

- All services from a single source
 - Customer- and application-oriented engineering
 - Support for process development, designing the process accessories and the installation layout by way of reliable scale-up
 - Reliable compliance with all agreed specifications, budgets and delivery deadlines
 - Complete assembly and testing of the installations in the ISO 9001 certified production facility
 - On-site assembly of certain installation types is also possible
 - Service network operating throughout the world
- ... which provide every customer with the necessary security.

PROCESS SECURITY

GEA combines top separating technology performance with comprehensive responsibility for reliable process management.

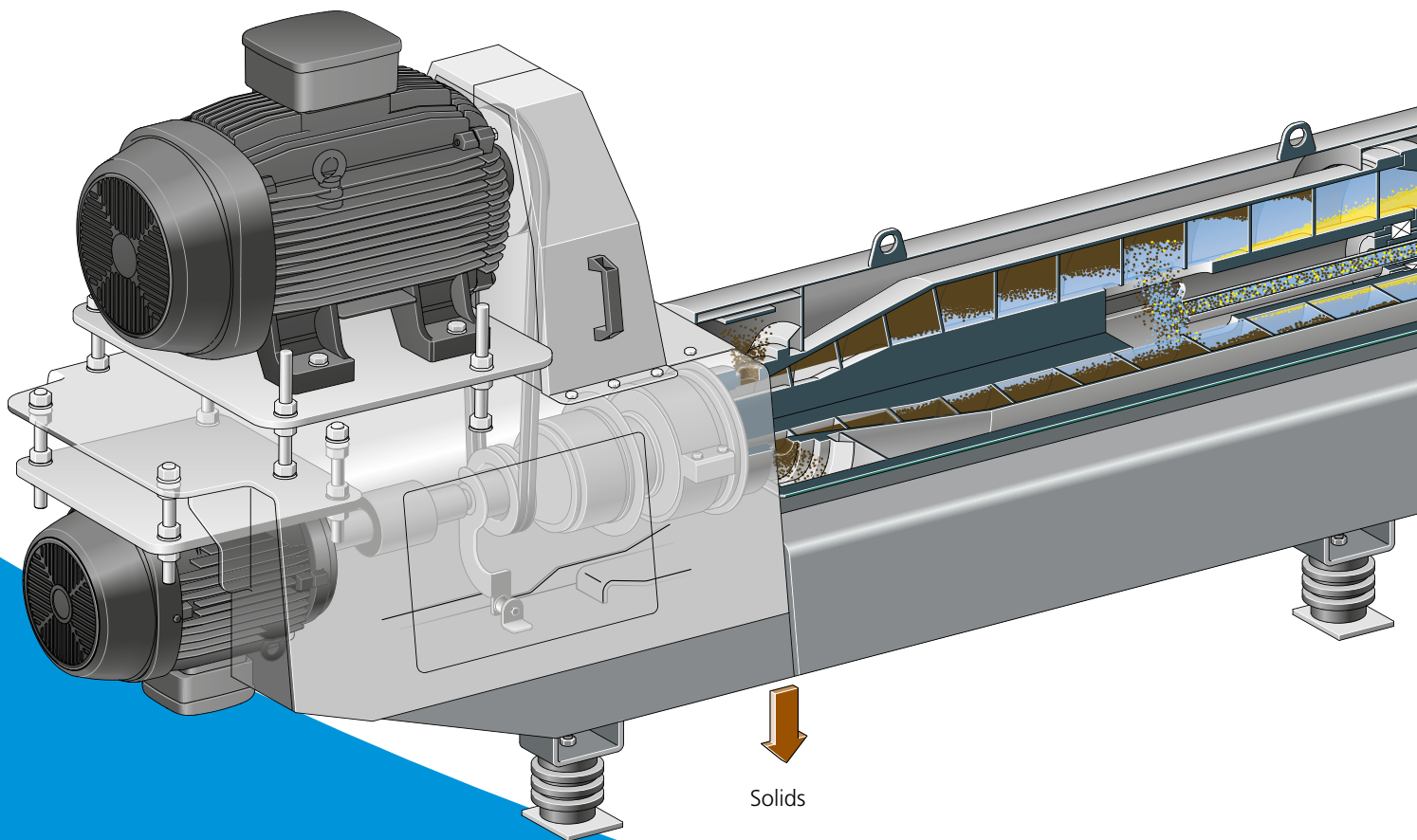


Decaners for efficient crud and clay treatment

Robust and flexible: 2- and 3-phase decaners from GEA set standards for crud treatment and solvent recovery.

Dekaners from GEA are usually used when the solid content in a suspension to be processed is greater than 20 % (by volume). Their main features are high separating efficiency, high-performance and reliability. With bowl diameters of 200 to 750 mm, GEA covers the complete range of capacities.

All decaners from GEA are characterized by robust processing so they operate reliably under the most difficult conditions. In addition to application-specific corrosion and wear protection, all parts of the decanter which come into contact with product are made from high-quality duplex stainless steels and are specially armoured.



Different special material can be chosen such as high quality alloys or the design of the decanter depending on the chloride ion content in the aqueous phase. If required by the product or if desired by the customer, special materials can of course also be used.

Sophisticated drive concepts ensure precise adjustment of the differential speed, which guarantees a high separating efficiency. The differential speed is automatically regulated while the machine is still operating, so that the decanter can be adjusted quickly and flexibly to cope with fluctuating feed conditions. Thus, the solids are discharged with a constant concentration and in an extremely dry state.

GEA varipond® – variable adjustment of the pond depth

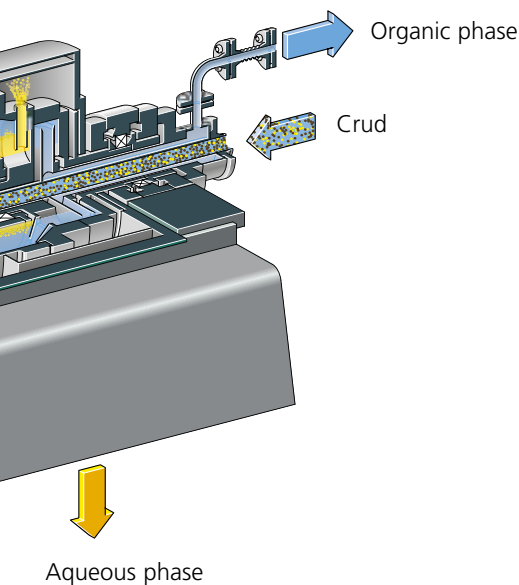
If the density conditions in the suspension, the crud, change as a result of external factors, e.g. dust, it can also be necessary to adjust the pond depths in the decanter. With the GEA varipond® system this can be carried out while the installation is still running. Production interruptions are avoided.

Born to run

The decanters from GEA are characterized by intelligent and compact design which ensures rapid access to all maintenance-relevant parts. This reduces the time needed for maintenance and service so that the decanter is back at work in virtually no time.

3-phase decanter

The 3-phase decanter separates the crud into solids, aqueous phase and organic phase. In the cylindrical section of the bowl, the aqueous and the organic liquid phases are simultaneously separated and clarified, whereas the conical part of the bowl is used for dewatering the solids. The scroll conveys the solids to the solids discharge. The aqueous phase is discharged under gravity while the solvent is discharged from the decanter by means of a paring disc under the exclusion of air.



Benefits at a glance:

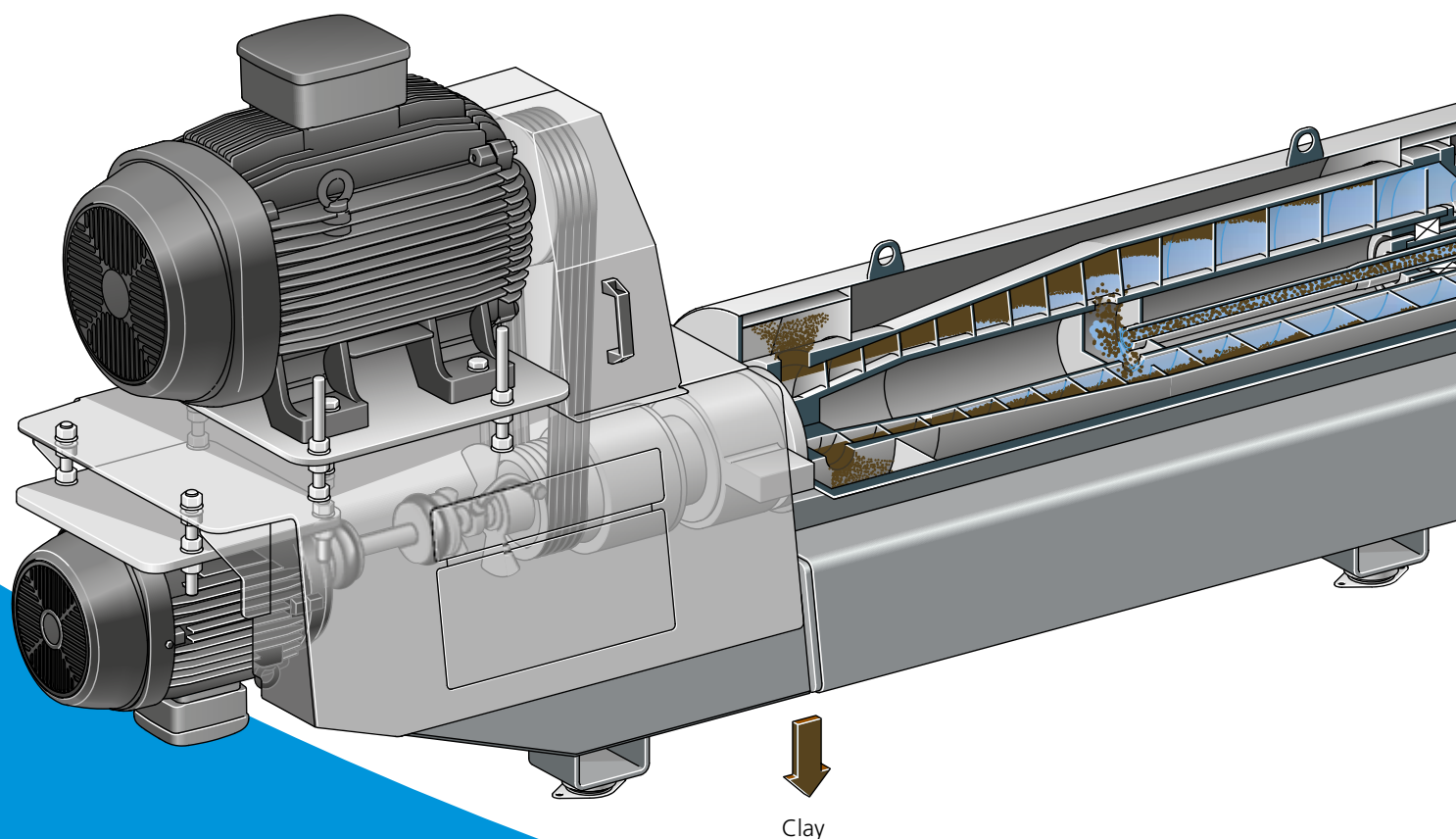
- Decanters with bowl diameters of 200 – 750 mm cover all operating sizes
- Robust design for permanent availability
- High-quality duplex steels and special armouring for maximum corrosion and wear protection
- Different special material can be chosen such as high quality alloys
- Inline adjustment of pond depth while the installation is still running due to GEA varipond®

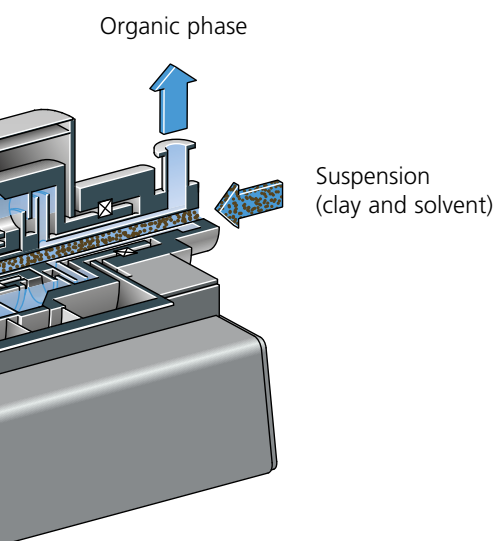
Recovering the solvent in the 2-phase decanter

Innovation with added value: by switching over to a 2-phase process, the 3-phase decanters can also be used for recovering the organic phase.

In addition to crud treatment, decanters have a further function to play in the processing of base metals: the recovery of solvent with high quality so that it can be recycled to the extraction process. In these cases, GEA offers its customers the possibility to use the same decanter first in 3-phase design

for crud treatment and then in 2-phase design for recovery. The advantage is that the customer only has to invest in one machine. However, the operations can only be carried out successively.





2-phase decanter

The repeated use of extraction agents leads to a deterioration in effect as a result of ion saturation of the radicals. In order to “clean” the radicals, absorption agents such as clay are added. The suspension to which clay has been added is fed into the decanter, where it is split into two phases.

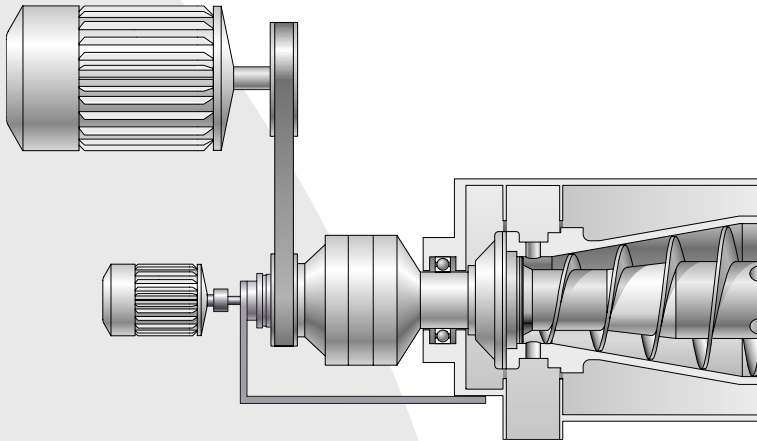
In 2-phase decanters, the clay is removed from the suspension so that the customer receives a virtually solids-free clarified organic phase. The solid-wall bowl of the 2-phase decanter illustrated in the diagram has a cylindrical section for efficient separation and clarification of the suspension as well as a conical section for efficient dewatering of the separated clay. The product is continuously fed into the rotating bowl via the feed tube and is accelerated to bowl speed. The clay sediments on the interior wall of the bowl due to centrifugal force; it is then scraped off by the armour-plated scroll and conveyed to the solids discharge. The level of liquid in the bowl and thus the lengths of the clarifying and dewatering zones can be varied depending on the feed conditions. The organic phase recovered in the decanter is discharged under pressure by means of a paring disc.

In consequence, this results in “clean” extraction agent for permanently efficient extraction.

Benefits at a glance:

- Possible use of the decanter for 3-phase and 2-phase processes
- Continuous recovery of the organic components
- Permanently “cleaned” extraction agent

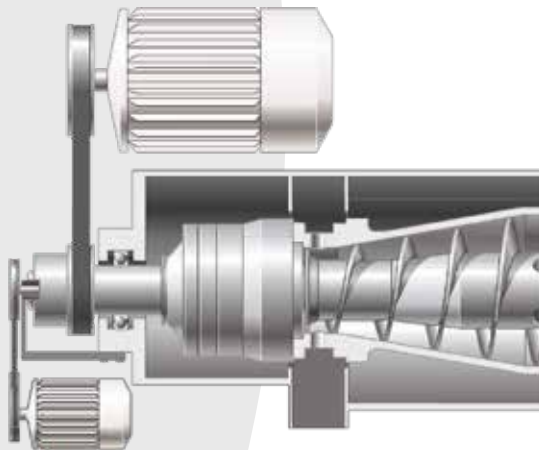
Innovative drive concepts for decanters



GEA summationdrive

The summationdrive 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.



Differential gear drive

The differential gear drive is recommended whenever it is necessary to automatically regulate the scroll speed in addition to regulating the bowl speed. This can be achieved by means of two gears. The secondary motor drives the central input shaft and generates the differential speed proportionally to its own speed. A second input shaft without any speed is connected to the housing.

This means that the differential speed is not dependent on the bowl speed. Differential gear drives are used primarily in the lower range of the differential speeds.

Decanter wear protection – no chance for abrasion and corrosion

GEA uses highly resistant duplex steel and special armour-plating for all parts which come into contact with product.

Crud treatment and recovery of organic components expose decanters to extreme material strain. The low pH value of the process (pH 2) and high operating temperature in conjunction with a range of high chloride concentrations result in corrosion. The only way to tackle this problem is to use an extremely high quality material. GEA therefore uses highly resistant duplex or super-duplex stainless steels for manufacturing all components of the decanter which come into contact with product.

This material is not affected by pitting, and also features higher abrasion protection than stainless steel which is normally used. In permanent contact with abrasive particles in metallurgy, this wear protection is an essential advantage.

In addition, all places at which increased levels of wear can be expected have to be provided with special armour-plating in order to ensure permanent operation of the decanter. The most suitable form of armour-plating according to the specific application is defined in close cooperation with the customer.

One possible solution is spray cladding, in which carbide is for instance welded on to the vane of the scroll or areas in the distributor. The advantage of this solution is that the protecting material combines with the base material in the welding process.

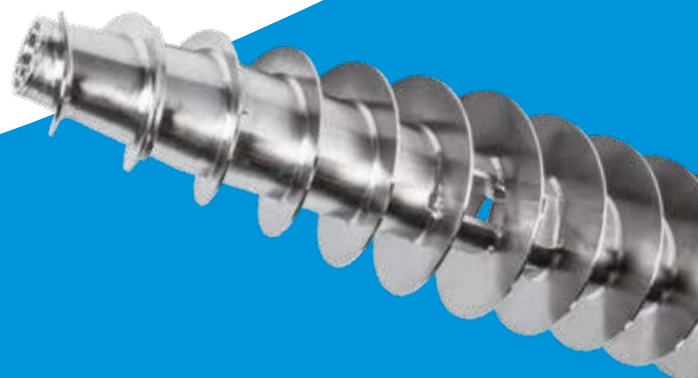
GEA also offers the possibility of using tiles instead of or in addition to carbide plating. Tiles are generally used in conjunction with highly abrasive products. GEA also has the know-how for cladding certain areas with ceramics in order to provide special protection.

Depending on specific requirements, GEA offers wear and corrosion protection in the form of

- Carbide cladding
- Tiles
- Ceramics
- Use of high-quality steels
- Rubber linings
- Coatings



GEA tackles problems posed by abrasive particles with special armourplating for all decanter components which are at risk.



Rotary brush strainers and wear protection

Upstream rotary brush strainers and a special coating for components which are at risk protect the separators against clogging and abrasion.

Excessively large solid particles can clog the nozzles of the separators. This is reliably avoided by installing a rotary brush strainer from GEA upstream.

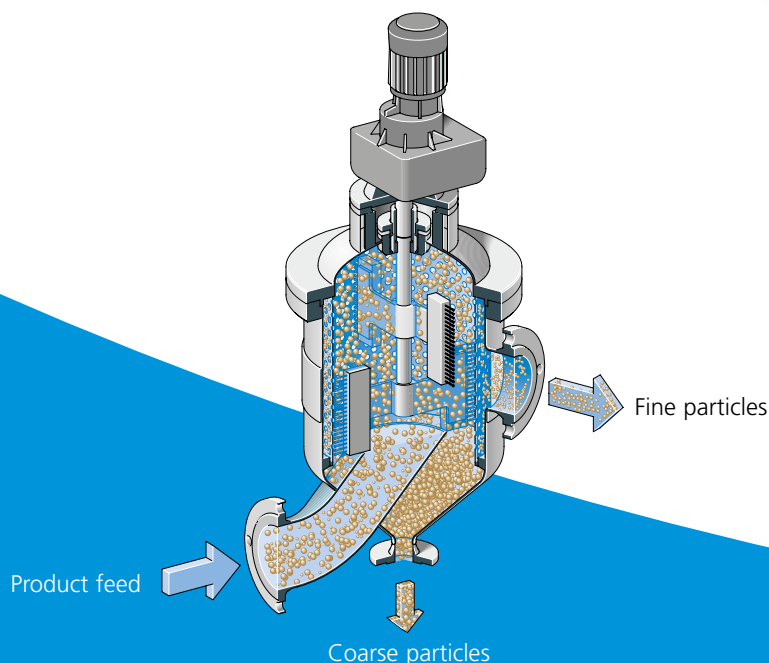
The product is fed into the strainer insert through the inlet, and flows through the strainer in the chamber to the discharge. The coarse solids are retained and scraped off the interior of the strainer by the rotating brushes. They fall into the conical base, from which they are discharged manually from time to time or automatically through the solids discharge.

Special coating against abrasion

In order to ensure that maximum performances are permanently achieved, the nozzle-type separators are also equipped with a special wear protection against abrasion. This solution comprises coated wear plates as well as a coating on the distributor bottom and the bowl bottom.

Benefits at a glance:

- Upstream rotary brush strainers prevent clogging of the nozzles
- Reliable protection against abrasion
- Maximum separation performance in the overall process
- Maximum maintenance intervals



Decanters from GEA – convincing right through to the smallest detail

Machine portfolio

- GEA as a complete-range provider for a range of 600 – 350,000 l/h

Special materials

- Parts which come into contact with product can be made of specific application-related materials, thus ensuring optimum resistance and product-neutral properties

GEA varipond®

- Automatic system for infinitely variable adjustment of the liquid level while the machine is running in order to adjust for product fluctuations in the feed
- Assures maximum dry substance values and separating efficiency in conjunction with different feed conditions, resulting in lower power consumption
- Assures optimum conveyance of highly viscous liquids – enhances conveyance efficiency
- Intelligent self-control

Separating zone adjustment during operation

- Assures optimum separation and clarification efficiency while the machine is running

Explosion-protected and gas- and pressure tight designs available

- Can be used for instance in explosive areas or for processing explosive or toxic products

Six scroll drive versions

- Drive versions tailored to meet the requirements of the specific process ensure maximum clarification and dewatering efficiency as well as cost-effectiveness of each individual application (energy and investment costs)
- All scroll drive versions are selected in accordance with product-specific characteristics

Adjustable bowl speeds

- Depending on suspension and/or solids densities the bowl speed can be adjusted by VFD

Wear protection

- Better availability, lower maintenance costs

Rotor concept

- Maximum speed, g-forces and g-volumes permit maximum throughputs and clarifying efficiency by use of product specific cone angle

Nozzle-type separators for efficient PLS clarification

Continuously operating nozzle-type separators from GEA are the first choice for efficient PLS clarification.

GEA Nozzle-type separators discharge concentrated suspensions continuously via nozzles which are installed on the periphery of the bowl. The product flows via the feed into the bowl, where it is separated into concentrate (underflow) and centrate (overflow). The disc stack which is installed in the bowl increases the equivalent clarification area and thus the performance of the separator.

The size of the bowl diameter and thus the number of nozzles are linked proportionately to the potential concentration of the concentrate. The concentration increases in conjunction with increasing throughput, high initial concentration of the product, declining solids content in the discharge, small nozzle diameter and a low bowl speed.

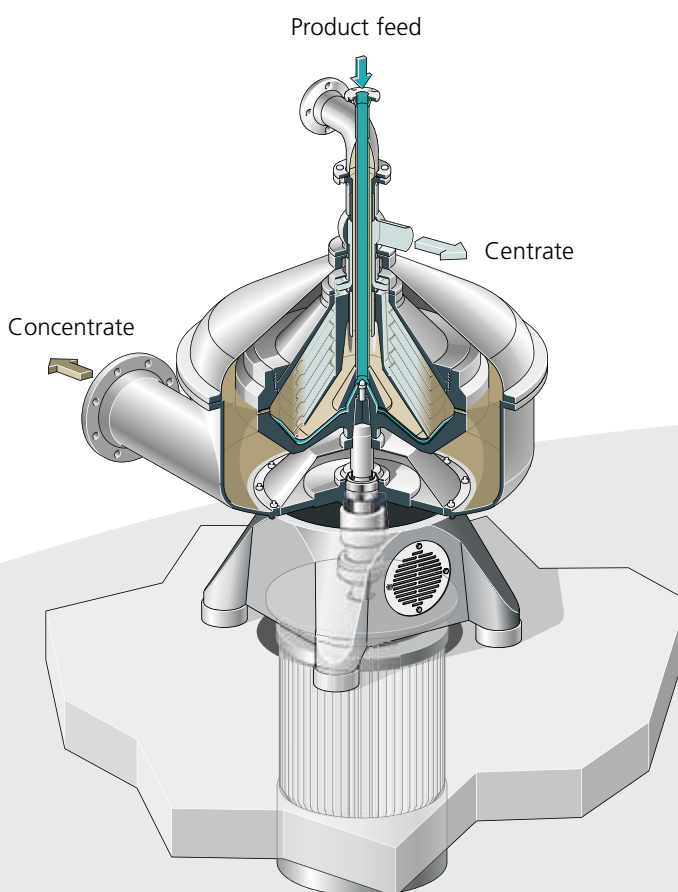
The task is to achieve a balance between these factors and the equivalent clarification area as a standard measure for the clarifying performance of the bowl, in order to make sure that the remaining solid content in the concentrate permanently meets the customer's requirements.

With the online analysis facility which is offered by GEA and which is based on measurement of the concentration of the product upstream and downstream of the nozzle-type separator, it is possible to adjust the clarifying performance of the centrifuge very precisely. The figures resulting from the concentration

measurements are used for automatically carrying out adjustments to the feed capacity and the concentrate recycling. This achieves constant concentration of the discharged suspension. Fluctuations in the process results can thus be reliably excluded.

Benefits at a glance:

- All operating sizes covered
- Continuous method of operation
- With concentrate recycling before the nozzle in order to increase the concentration
- Sophisticated online analysis for stable process conditions
- Direct drive for optimum energy efficiency and low service costs



Separators used for cleaning the refining stream

Separators from GEA assure higher process efficiency.

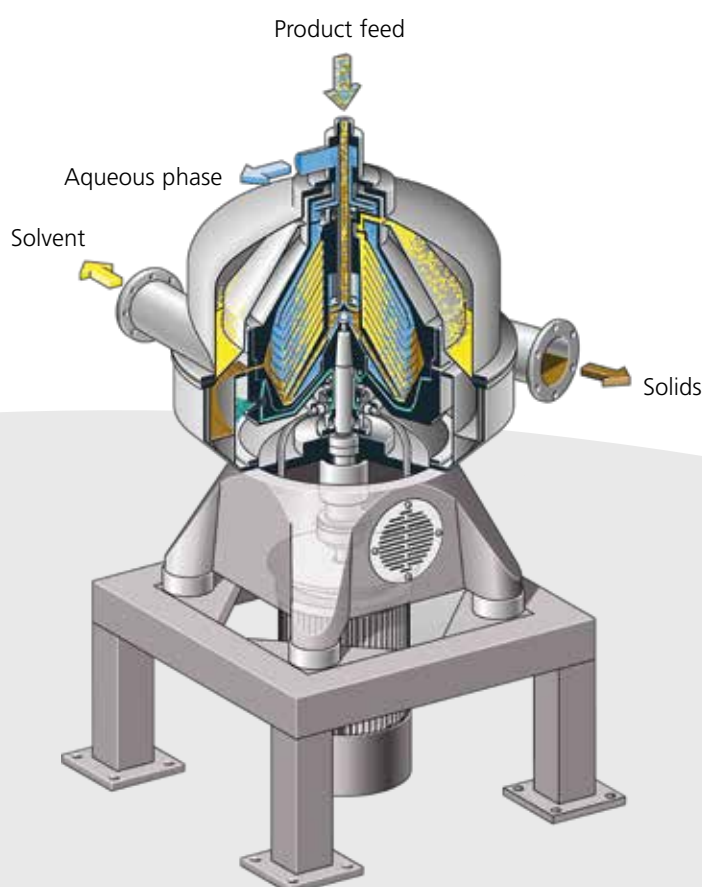
GEA Separators can be used for cleaning the product stream and removing the remaining solvent before electrolysis stage. The advantage of this solution is that the electrolyte bath has to be replaced much less frequently – with a positive impact on operating and disposal costs.

This separator is equipped with a self-cleaning disc-type bowl. The solution itself is separated in the disc stack into a light and a heavy liquid phase. At the same time, the solids which accumulate in the bowl space are removed by centrifugal force. At regular intervals, the bowl opens automatically via the piston valve and ejects the solids. The light liquid phase (solvent) flows towards the centre of the bowl through the disc stack, and is discharged via drill holes in the hood. The heavy liquid (aque-

ous phase) flows to the periphery of the bowl via the separating disc, and is also discharged under gravity. The new generation of separators for liquid-liquid separation covers the entire range of possible capacities. They feature a high motor performance and optimum dynamic qualities with low energy consumption. Further advantages are to be seen in the high reliability, simple operation and low maintenance costs. The process is suitable for recovering copper, nickel, cobalt and uranium.

Benefits at a glance:

- Self-cleaning bowl for automatic discharge
- Hydrohermetic product feed for gentle treatment
- Flexible adjustment of the separating zone for maximum separating efficiency of the liquid phases
- Direct drive for optimum energy efficiency and low service costs
- Closed feed and discharge for the product phases
- CIP cleaning for reliable operation with constantly high yields
- Explosion protection design (ATEX compliant)



Drive concept for separators



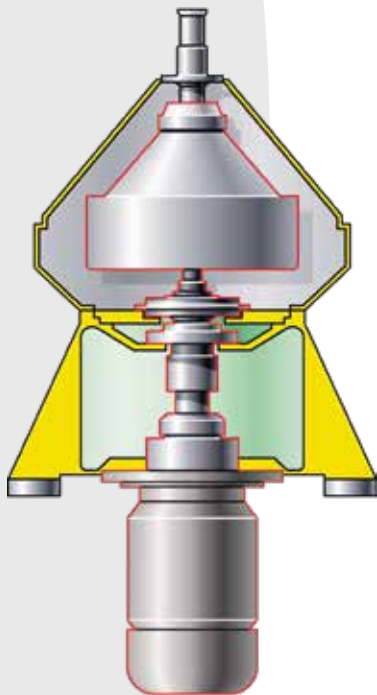
GEA Integrated directdrive^{co}

The energy-efficient drive technology

GEA integrated **directdrive** ensures direct power transmission from an integrated frequency-controlled-phase motor to the bowl – without separate high-maintenance bearings.

Benefits at a glance:

- Improved level of efficiency ensures significant energy savings
- 35 % reduced space requirement for the separator
- Exceptionally maintenance-friendly drive concept
- Water-cooled motor works considerably more quietly than a conventional one
- Product feed and discharges in the bowl do not feature mechanical seals



Direct drive system

The direct drive is an example of intelligent simplification in separating technology. Wherever the upper limit for gear loads has been reached or belt drives are undesirable, our separators with direct drive permit virtually loss-free power transmission. This boost in performance simultaneously reduces the costs of energy, wear, maintenance and space. The required power is transmitted directly to the bowl spindle by a 3-phase AC motor with frequency converter control via a torsionally elastic clutch. The spindle assembly is likewise supported by rubber-metal cushions. This makes possible low-vibration running at high bowl speeds.

Benefits at a glance:

- Extremely space-saving design
- Avoidance of housing deformation
- High performance input
- Low maintenance requirement

Separators from GEA – convincing right through to the smallest detail

Machine portfolio

- GEA supplies a complete machine portfolio (capacity up to 350,000 l/h) with compatible hydraulic performance parameters/ performance reserves – the right separator for every customer requirement

Modular total concept

- Customized solutions and delivery as required by customers

Operating the separators

- Personnel-friendly operating of the separators and, if required, 100 % remote-monitored operation possible, thus enhancing operational reliability and availability
- Combination of maximum robust nature and reliability
- Low water consumption as no cooling necessary for the drive and the slide ring packings

Special materials

- All product contacting components can be made of special metals, clad with special metals or coated resulting in optimum resistance against corrosion

Discharge and feed design

- Feed design can be adapted to product requirements
- Clarified liquid is discharged foam-free under pressure by use of a centripetal pump. Available discharge pressure is minimum 4 barg which makes the need of transport pump unnecessary

Direct drive

- Drives are low-wear and service-friendly
- Use of lubricants approved for food applications
- Available in explosion-protected design and ATEX-compliant
- Special drives possible if required by customer

Rotor concept

- Flow-optimized design (minimum flow resistance, minimum shearing forces) of all bowl parts assures optimum separating and clarifying results with minimum product damage
- Maximum speeds (g-forces)/equivalent clarification areas achievable

Global test center network

Innovate, partner and prosper with GEA

Driving your future	Driving solutions	Driving technologies
By combining advanced in-house technology with a thorough understanding of the processing industries, we help our customers to maximize their development results, gain more know-how and discover additional opportunities for their applications.	From new product and feasibility trials to scale-up studies, training programs and process support, we believe that our services greatly benefit anyone involved in industrial R&D, equipment selection, process optimization and product development.	Overcoming technical barriers throughout the entire process chain, there's no limit to where the GEA global network of test centers can take your research.

The GEA global network of test facilities offers teams of experts who work closely with their customers to optimize procedures and evaluate their products, enabling them to achieve their process and production goals.

GEA test center Separation

At the GEA test center of competence, customers can test both new and established products in a wide range of separation operations or perform comparative process studies with our skilled operators. Other test programs in GEA test centers around the world can be involved to test entire manufacturing lines.

Prosper with GEA

Book your ticket to success at

gea.com/contact

On-site trials and technical center

Centrifuges are available for process trials at the operator's site to assess the feasibility and profitability of individual process steps and combined operations.

In co-operation with the customer, GEA also develops and tests completely new processes. In this way, the GEA test centers also underline the innovation strength of GEA as a leading international technology group.





GEA Global Test Center

GEA Service – For your continued success

GEA Service offers dedicated teams of service experts. Our focus is to help our customers build, maintain, and improve their performance, market presence and competitive edge for the entire life cycle of their plants and equipment.

Partnering with GEA gives you the benefit of our world-renowned, customer-tailored service and recommended spares upgrade, modernization and optimization services. With our support you can be certain that every piece of GEA equipment and technology will operate optimally from day one, and for its complete lifespan, to give you maximum return on your investment.

- Getting you started – Seamless support for instant productivity and performance
- Keeping it running – The cost-efficient way of ensuring the safety and reliability
- Constantly improving – Sharing our knowledge to safeguard your investment
- Together with you – Enduring commitment to you and your business



GEA Service - For your
continued success



consulting &
operations

Life Cycle
Service

Extended Life

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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