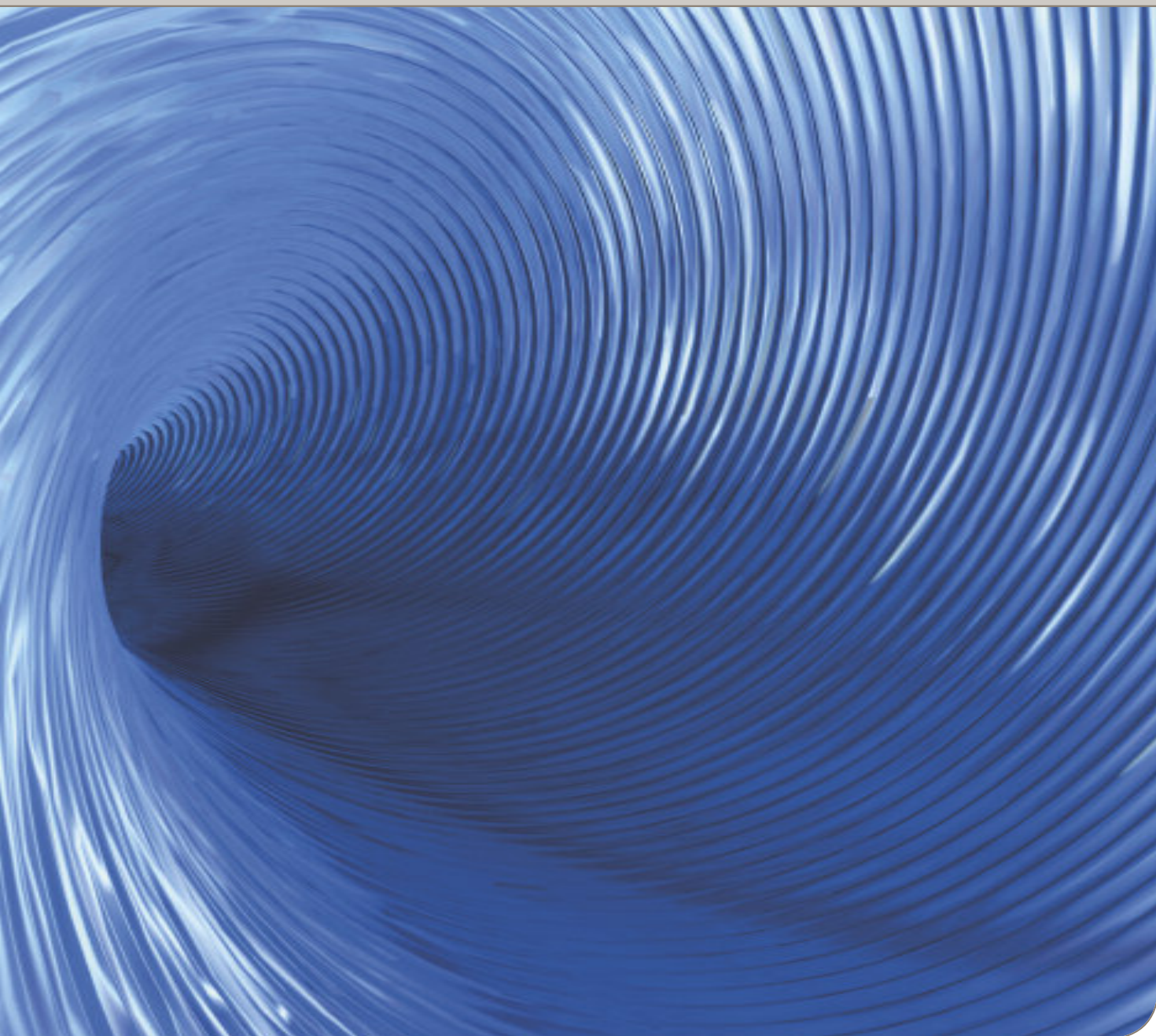




Alfa Laval – disc stack separator technology

Controlling the separation of liquids and solids



Alfa Laval – disc stack separator technology

Separating different liquid phases and solids from each other plays a key role in countless industrial processes.

Alfa Laval has been at the forefront in this field for well over 110 years – which is why disc stack separators from Alfa Laval perform this crucial separation function exceptionally well.



Working principles

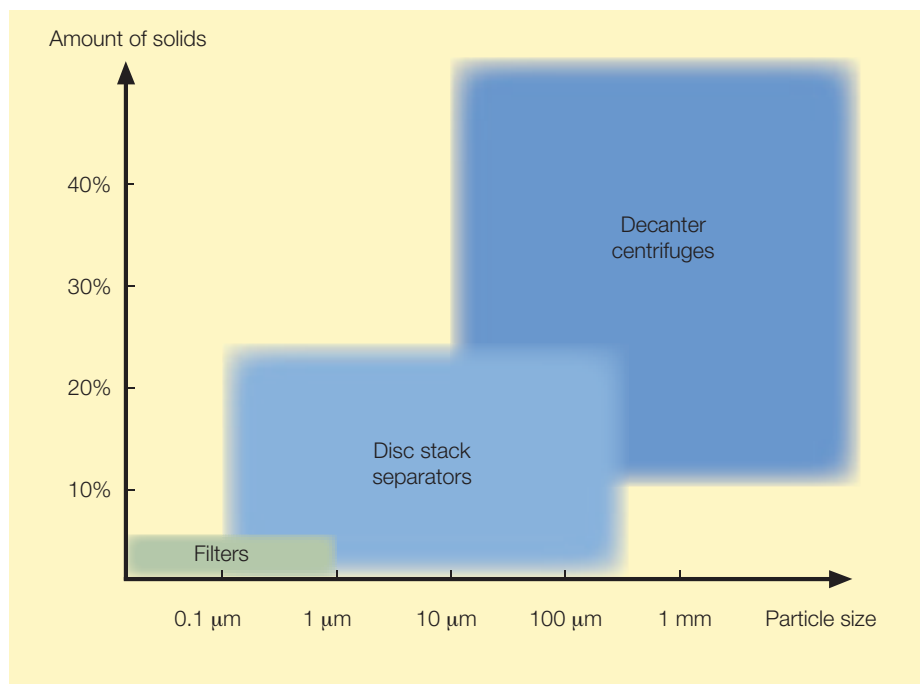
A brief general explanation of how disc stack separators work

Continuous separation

Virtually all branches of industry need to separate different liquid and solids at some point in their manufacturing processes. Alfa Laval has well over a century of experience in meeting these requirements using different kinds of centrifuge technology.

The basic centrifuge idea is based on what happens in a settling tank, in which particles, sediment and solids gradually fall to the bottom, and the liquid phases of different density separate due to the force of gravity.

However, such clarification is an extremely slow process and is unable to meet industry's needs for rapid, controllable results. The general idea behind centrifuges is therefore to ensure that the mechanical separation of different liquid phases and solids can be carried out on a rapid, continuous basis in order to meet the demands associated with modern industrial processes.



Kinds of equipment normally used for solids separation

Accelerating the process

In essence, a centrifuge is a settling tank whose base is wrapped around a centre line. Rotating this entire unit rapidly means that the effect of gravity is replaced by a controllable centrifugal force that can have an effect up to 10,000 times greater.

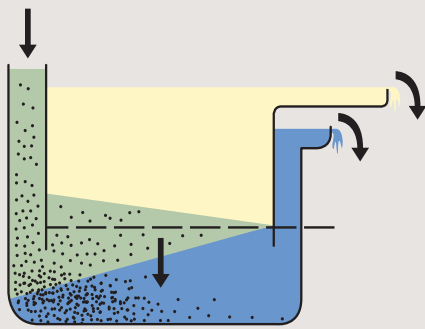
This force is then used to separate liquids from other liquids and solids efficiently and with great accuracy, and in a manner that is easy to control.

Types of centrifuge

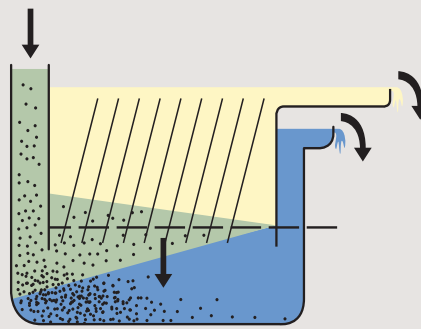
There are several different basic types of centrifuge normally used in industrial

separation. Decanter centrifuges are generally used for greater solids concentrations with larger particle sizes. Disc stack separators, on the other hand, are ideal for a wide range of separation tasks that involve lower solids concentrations and smaller particle and droplet sizes. This applies to both liquid-liquid and liquid-solid separation.

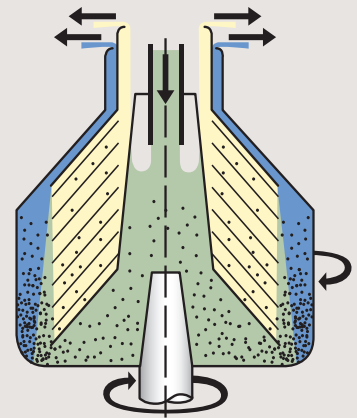
The most difficult separation tasks can often involve three phases, with hardly any difference in the density of the separate liquid phases and with the particles to be separated very small in size. In such applications, no other technology can compete with disc stack separator technology.



Settling tank



Settling tank with discs



Disc stack separator



The clarified liquid phase (or phases) overflow close to the rotating axis, in the outlet area on top of the bowl. The liquids then flow into separate chambers. Each separated liquid phase then leaves the bowl due to the force of gravity or by means of a paring disc, which is a special pumping device. The chambers can be sealed off from each other to prevent any risk of cross-contamination.

How a disc stack separator works

A disc stack separator separates solids and one or two liquid phases from each other in one single continuous process, using extremely high centrifugal forces.

When the denser solids are subjected to such forces, they are forced outwards against the rotating bowl wall, while the less dense liquid phases form concentric inner layers.

The area where these two different liquid phases meet is called the interface position. This can be easily varied in order to ensure that the separation takes place with maximum efficiency.

Inserting special plates (the “disc stack”) provides additional surface settling area, which contributes to speeding up the separation process dramatically. It is the particular configuration, shape and design of these plates that make it possible for a disc stack separator to undertake the continuous separation of a wide range of different solids from either one or two liquids.

The concentrated solids phase formed by the particles can be removed continuously, intermittently or manually, depending on separator type and the amount of solids involved in the specific application.



The whole is the sum of parts

Advanced technology involves many forms of specialist know-how

Disc stack separators normally feature four main sections.

Inlet zone

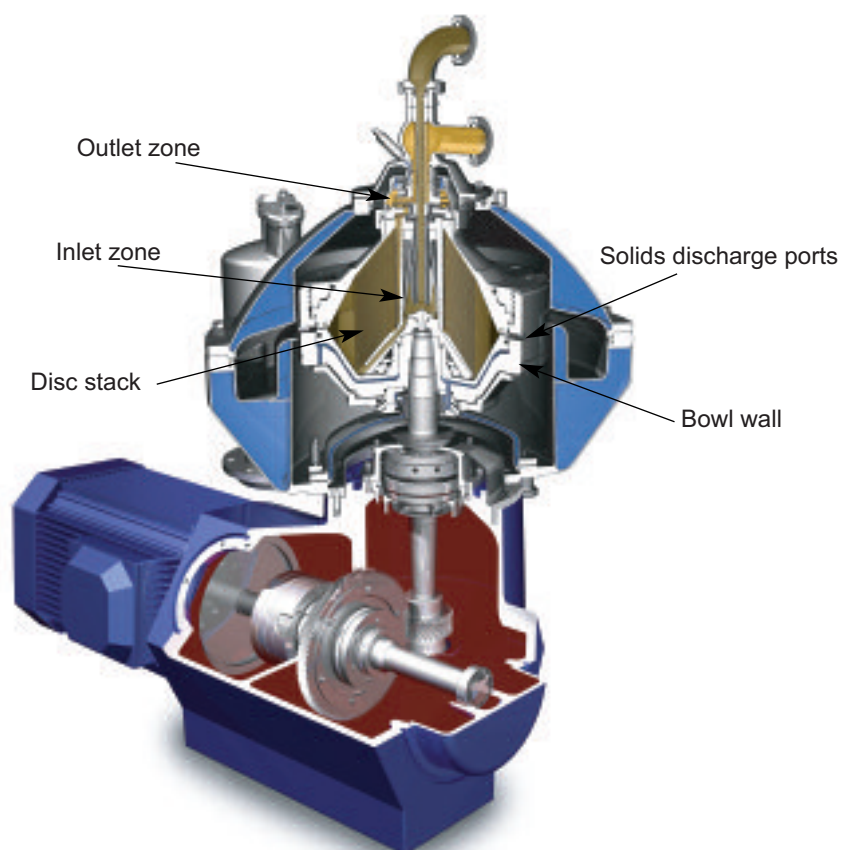
The inlet zone accelerates the process liquid up to the speed of the rotating bowl. A properly designed inlet zone makes sure that the feed solids and liquids are not degraded or affected in any other way. Good inlet design also prevents foaming, reduces the sheer forces in the product, minimizes temperature increases and avoids disturbance of the separation processes taking place in the bowl.



A number of different inlet configurations are available for Alfa Laval disc stack separators, each designed to ensure maximum performance in conjunction with a specific process.

Disc stack area

The key to good separation performance lies in the efficiency of the disc stack, which is the heart of the separator. The design of the disc is therefore crucial.



Alfa Laval has the expertise needed to match the demands associated with specific industrial processes by providing particular disc stack configurations that ensure a flow evenly spread among the discs, along with an optimized flow pattern in the disc stack itself.

The layout and design of the distribution holes also have a crucial influence on good performance. These ensure that the process flow is evenly spread among all the discs, for the most efficient results.

Liquid discharge section

Once separated, the liquid must often be conveyed out of the separator as delicately as possible. In some applications, it is important that oxygen pick-up is kept to a minimum, and that temperature increases in the liquid must be avoided in order to prevent problems later in the process. Alfa Laval has designed solutions to these and many other detailed requirements, in order to provide our customers with the best possible process conditions for their operations.



The most straightforward way of discharging the liquid phases is the use of open outlets.

In most applications, however, a head of pressure is needed. This is created by a stationary paring disc with specially designed channels. This disc decelerates the rotating liquid and transforms the kinetic energy from this into pressure, thus pushing the liquid out of the separator via the channels in the disc. The pressure needed for the particular process is normally regulated by a valve on the outlet.

Solids discharge section

There are three basic ways of removing the solids from disc stack separators

- continuous solids discharge, in which solids and liquid exit via nozzles in the periphery
- intermittent solids discharge, in which a carefully designed system opens ports in the bowl periphery at controlled intervals in order to remove the collected solids
- manual removal, in which the machine is stopped and the bowl is opened so that the collected solids can be removed manually.

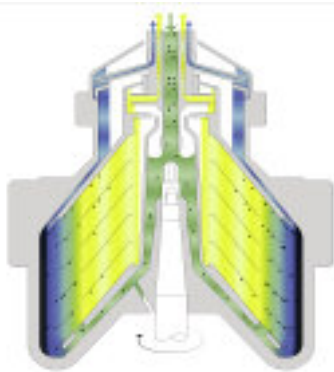
The solution most appropriate for a particular application depends on a combination of factors. The most important of these are the amount of solids in the liquid, the nature of the particular application and the consistency of the solids once they have been separated.

Separator system

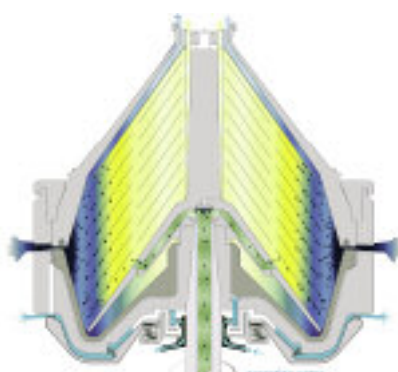
Naturally, the overall efficiency of a disc stack separator as part of a production set-up is heavily dependent on many other ancillary systems and equipment.

Unparalleled experience means that Alfa Laval has a unique capability for providing all the necessary equipment to achieve maximum efficiency in the continuous separation of different liquid phases and solids in countless industrial processes.

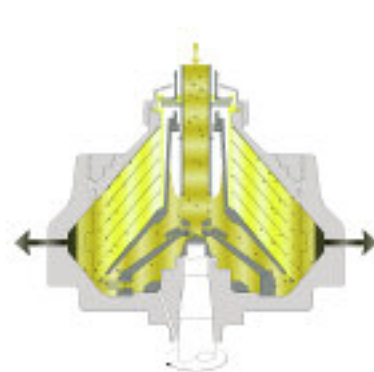
This can be done on the basis of highly efficient, standardised equipment packages and fully tested modular units, or specially customized disc stack separator installations to meet individual liquid-liquid and liquid-solid separation requirements.



Solids retention



Intermittent solids discharge



Continuous solids discharge

The keys to exceptional performance

The Alfa Laval difference

The ability to separate the liquid and solid components of often highly complex, high-value processing streams – and to do so with meticulous control, low cost and high reliability – requires disc stack separator technology that is second to none. When the profitability of an entire process is at stake, it is important that the customer has a partner that can be relied on to meet the highly complex demands associated with modern industrial separation.

History, experience and expertise

Alfa Laval has more than one hundred and ten years of practical experience with the design and manufacture of high-performance disc stack separators. Alfa Laval therefore has a highly comprehensive body of knowledge relating to the use of disc stack separators in countless applications.

We are able to combine this knowledge with the results of our R&D work, making it possible to undertake continuous improvements in the performance of Alfa Laval disc stack separators in order to optimize the results that our customers can get from their industrial processes.



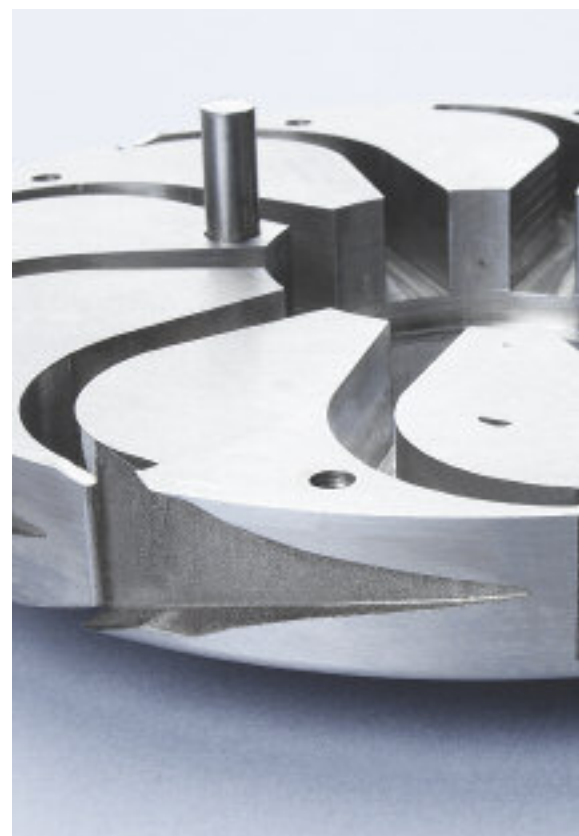
Technology leadership

Alfa Laval conducts extensive R&D in all the technologies associated with the design and operation of disc stack separators. Our know-how and specialist process experience put us in a unique position to match the exact needs of each customer and each particular application and installation.

• Fluid dynamics

A disc stack separator only works satisfactorily if the liquids are handled correctly. Some applications depend on smooth handling for good separation results and to maintain the quality of the end product. In others, oxygen pick-up or temperature increases are completely unacceptable. The flow through the inlet is also crucial when handling soft solids, and in ensuring low shear forces in delicate liquids and solids.

Considerable specialist knowledge and advanced machining capacity are required to design and manufacture the extensive range of angled and curved disc stack spacers and specially



shaped paring discs required to meet the needs of modern process industry.

More than 25 years of in-depth studies in fluid dynamics have given Alfa Laval exceptional knowledge and insight into the complex details of what takes place inside the disc stack separator during operation. This is reflected in the design of our equipment and is a major advantage when dealing with specific customer demands.

Technology leadership

- Fluid dynamics
- Materials technology
- Ancillary technologies



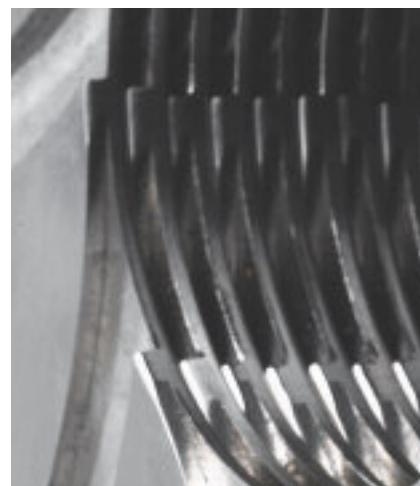
reliability, all bowl parts are die forged. This provides a bowl that is completely weld-free as well as ensuring that the parts feature a uniform grain structure free from flaws and defects.

However, these are not the only challenges a disc stack separator must meet. The liquids being processed can contain abrasive particles or require the use of advanced sealing technologies. Alfa Laval has extensive application experience that has enabled us to build up a vast list of special materials that we can make available to customers in order to meet virtually any process challenge. These include many advanced stainless steels, tungsten carbide, nickel-based alloys for use in special environments, and special polymeric and ceramic sealing compounds.

The results are maximum strength, unparalleled reliability and prolonged service life. In disc stack separators, the correct choice of materials for each component is crucial for operational reliability and commercial success.

- Ancillary technologies
- Because of the strength and reach of Alfa Laval's industrial capacity, the company is able to optimize the ways in which disc stack separator technology can be implemented in conjunction with other equipment and processes.

Our exceptional know-how about



ancillary technologies, control systems and technical interfaces make it possible to extract crucial marginal advantages from disk stack separator technology.

- Materials technology

One of the major challenges for disc stack separators is that they often have to deal with the combination of a highly corrosive environment and the extreme stresses that stem from operating with forces of more than 10,000 G. Only relatively few materials can cope with this. We therefore use advanced high-strength stainless steels, such as duplex and superduplex stainless steel, in the design of Alfa Laval disc stack separators. To ensure maximum

Meeting the challenge

Virtually every form of processing industry all over the world relies on being able to separate a wide variety of liquids into their component parts, in addition to separating solids and particles from liquids.

Application examples

Energy and the environment

Much of the world's energy from diesel, turbine and nuclear power stations is generated with the help of disc stack separators from Alfa Laval. We also help industry in general and the oil and gas sector in particular to purify wastewater and industrial fluids, and to handle slop oil. The Processes producing bio-diesel fuel use disc stack separators from our company. Notable challenges in the field of energy and environmental engineering include:

- **Removing heavy phase liquids/fine solids from a light phase liquid**

In gas turbine fuel treatment, Alfa Laval disc stack separators perform a key role in conditioning gas turbine fuels by removing water, salt and solids to prevent these damaging the turbine. This often involves removing small amounts of heavy phase liquids and fine solids from a light phase liquid, in order to achieve the required high degree of purity.

- **Bio-diesel production**

The chemical process to convert vegetable oils from raw material such as rape seed into diesel fuel use disc stack separators in several steps, separating the fuel from methanol or water.

- **Removing light phase liquid/fine solids from a heavy phase liquid**

To achieve maximum cleanliness in conjunction with the cleaning of deckdrain and other water on offshore platforms, Alfa Laval disc stack separators remove oily contaminants with a high degree of effectiveness. This means that the water can be safely returned to the sea with no damage to the environment.

- **Breaking up tight oil/water emulsions stabilized with particles**

Alfa Laval disc stack separator equipment is able to separate widely ranging emulsified mixtures of oil, water and solids from oil platforms, refineries and other sources. For slop oil, this makes it possible to reclaim the oil at the same time as eliminating a potential environmental hazard.





Process industry

Alfa Laval helps process industry customers to optimize their performance and deal with their separation process challenges across a wide range of industries. Alfa Laval know-how, combined with our extensive range of equipment, serves industries that include chemicals, petrochemicals, steel, paper, sugar and starch. Notable challenges in the process industry field include:

- **Ensuring clean oil additives**

In the production of oil additives, Alfa Laval disc stack separators remove any excess fine solids such as metal salts, lime, etc. that might be present.

With disc stack separator units capable of running at temperatures in excess of 200°C, Alfa Laval provides customers with a continuous, sealed process that replaces traditional filters. This makes it possible to avoid filter losses and the operating costs and consumables associated with filter equipment – and there are no hazardous wastes for deposit.

- **Sorting abrasive particles by size**

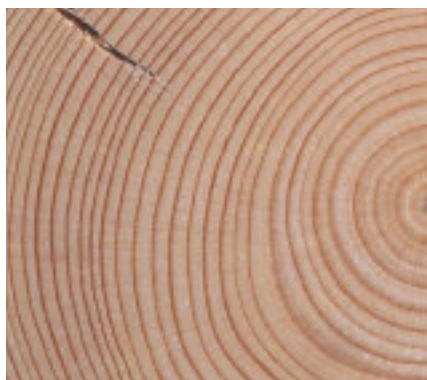
Alfa Laval equipment helps manufacturers of kaolin-based paper coating material clean and classify the kaolin in one single process, by sorting it on the basis of particle size.

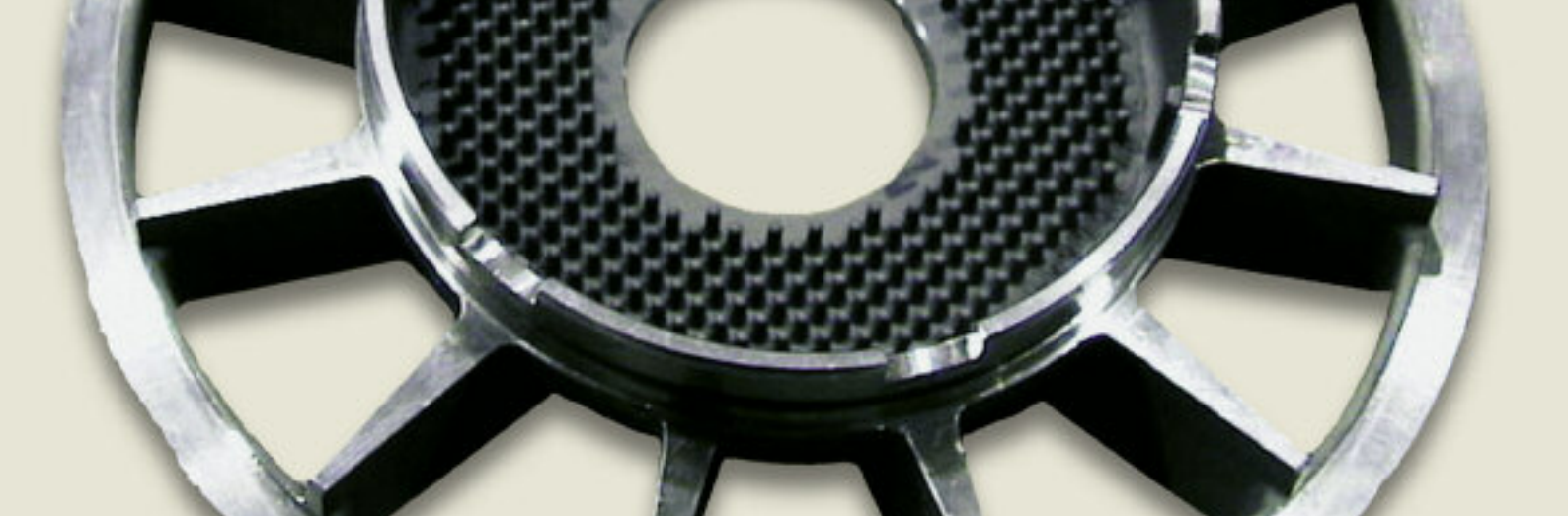
Alfa Laval disc stack separators are available with a special design that provides a high degree of resistance to the abrasion caused by kaolin. This results in equipment that is highly reliable, providing customers with low service requirements that can be a major advantage in the often-remote locations of kaolin mines.

- **Improving equipment service life**

Disc stack separators from Alfa Laval often play a key role in customers' processes in a rather indirect way.

Separating out water and other impurities and removing metal particles from a wide variety of oils and lubricants means that process motors, compressors, hydraulics, production lines, etc. are more reliable and have an extended service life. This kind of treatment can either be done continuously or by using mobile hook-up solutions.





Life science

Alfa Laval disc stack separators are widely used in the biotechnology and pharmaceutical industries. For decades, Alfa Laval technology has been widely used in the harvesting of microorganisms. However, recent developments in the field of genetic engineering and cell culture processing have now made it possible for the biopharmaceutical industry to develop and produce a whole range of new therapeutic products and treatments. Because they provide customers with exceptional reliability, hygiene standards and performance, Alfa Laval disc stack separators play a crucial role in these technically advanced processes. Among the major challenges in this field are:

- **Producing sensitive vaccines and antibodies under sterile conditions**

There have been radical developments in new vaccines for many different diseases and ailments, from hepatitis and influenza to snake bites.

Alfa Laval provides disc stack separators that make it possible to turn these research developments into commercially viable production by meeting the challenge of making the equipment fully contained, easy to sterilize and completely safe for the staff supervising the process.

Antibodies are also very difficult to separate and recover. Alfa Laval's unparalleled understanding of fluid dynamics paves the way to unprecedented results in this delicate field, where hygiene and sterility are paramount.

- **Separating delicate mammalian cell cultures**

A completely new generation of drugs and medicines – derived from mammalian cell cultures – is currently emerging. These organisms are extremely delicate.

This means that any separation processes must involve the most gentle and low shear acceleration possible. The ability to adhere to exceptional standards of hygiene is also a key issue.

Alfa Laval's unique fully hermetic solids disc stack separators with intermittent discharge are specifically well suited for this task.

- **Undertaking a huge range of different cell separation tasks**

Many different microbial cells are used in the production of antibiotics and other medicines. The particular type of product (intracellular, extracellular or inclusion body), the characteristics of each particular organism (bacteria, yeast, mycelium, etc.), the required flow rates, the need for absolute sterility and the need for full containment are all important considerations when a customer needs to decide on a specific separator solution.

Alfa Laval has the both the experience and the technical know-how to meet all customer needs for a huge range of different cell separation tasks, providing both intermittent and continuous solids discharge using either disc stack separator or decanter centrifuges.





Food processing

Alfa Laval is prominent in a considerable number of food production activities and processes throughout the world. Disc stack separators are used in food industries of all types and are designed to suit the specific requirements associated with each application and separation duty. Special features are available to minimize oxidation and product temperature increase. These can be combined with special designs to allow for the stringent standards of cleanliness and hygiene demanded by the food industry.

Disc stack separators meet a whole spectrum of customer needs, from small, seasonal olive oil and wine operations to large systems integrated into customers' manufacturing processes that work around the clock, such as in breweries and vegetable oil plants.

Among the major challenges in the field of food production are:

- **Reducing kieselguhr consumption and increasing filterability**

Beer is passed through kieselguhr filters to reach the required standards of clarity and brightness. Alfa Laval disc stack separators make it possible for breweries to significantly reduce the amount of kieselguhr used and to exploit the capacity of such filters in full, saving both time and money. The disc stack separators include special design features to eliminate oxidation of the beer and to minimize product losses.

Reducing energy and chemicals consumption in the vegetable oil industry

Improving product quality and reducing losses in vegetable oil refining, along with efficiently removing gums and soap stock during production, all contribute to profitability. Inventions such as the Centrizoom adjustable paring device enable fine tuning during production so that highly viscous gums can be removed from the oil. Hermetic inlets and special disc configurations provide excellent separation capability and reduce the consumption of both energy and chemicals.

- **Creating the best quality olive oils**

All top-quality extra-virgin olive oils have one thing in common. They are processed in high-speed separators to remove both the remaining fines and any small amounts of water left after upstream processing.

Features that ensure efficient separation along with a minimum of heating and oxidation of the oil are integral parts in Alfa Laval disc stack separators for olive oil processing.

- **Recovery of cold-pressed lemon oil**

Eteric oils extracted from lemons are used to create flavours and aromas in a large number of different products, including confectionery, beverages and cosmetics.

The delicate nature and the high value of these oils require specially designed separators. Completely hermetically sealed units with carefully designed inlets and outlets make it possible to avoid product deterioration and losses, thus ensuring maximum yield.



Nonstop performance



Service counts

In modern industrial processes, efficient, well-planned service plays an important part in maintaining profitable operations.

Full control

Alfa Laval operates with a highly sophisticated Nonstop Performance concept made possible by our worldwide network of service and spare parts distribution centres in more than fifty countries throughout the world.

Alfa Laval has full control over the entire supply chain, which means that we can provide customers with response times, availability and lead times that are second to none.

Service when it fits in

The service requirements for Alfa Laval disc stack separators are minimal, and planned preventive maintenance is the key to making sure this always remains the case.

Alfa Laval's worldwide service capabilities and vast experience with the contract maintenance and service of disc stack separators ensure that any service work required involves the absolute minimum of disturbance to operations.



Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineered solutions.

Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuffs, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

How to contact Alfa Laval

Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com

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