A global call for ethanol

Alfa Laval solutions for the fuel ethanol industry

One source, many benefits

We are the experts you can rely on for technically innovative heat transfer and separation solutions for fuel ethanol production.

Alfa Laval's proven, long-term track record in the fuel ethanol industry ensures you the full benefit of our accumulated know-how and experience in this field – from one single-source supplier.

With a product range that extends from pre-treatment, fermentation, distillation and dehydration to stillage dewatering and evaporation, we can provide you with the most efficient heat transfer and separation solutions currently available for each phase of your fuel ethanol processing requirements.

Booming market for fuel ethanol

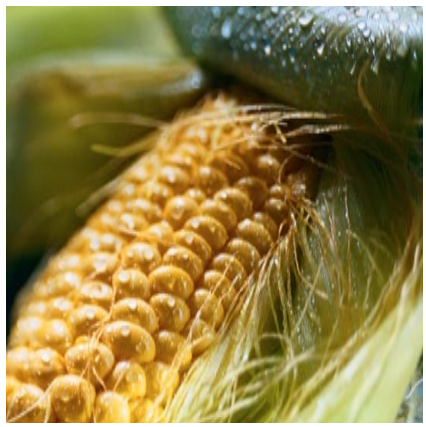
Dramatic change
It has been shown that renewable fuels can replace fossil fuels in virtually any required proportions. Consequently, there is growing worldwide public and political support for alternative fuels.

- Within the EU it has been decided that all petrol/diesel must contain a certain portion of renewable fuels.
- Within just a few years, the US market has evolved to become the largest producer of fuel ethanol in the world.
- Brazil pioneered the use of ethanol in the 1970's and is still in the lead when it comes to cost-effective production.

Other countries are rapidly following suit. The worldwide fuel ethanol market is currently undergoing a dramatic change with an increasing demand.

New opportunities, new players
Some new companies are seeking to take advantage of these opportunities. Others are experts seeking to expand. Whether your company is new or a well-established producer, Alfa Laval has the specialized equipment, the process know-how and the experience you need to capitalize on this booming market.

Your core equipment
– our core competences
Heat transfer and separation are vital to reduce energy consumption and to optimise the process. It is precisely these technologies that are at the heart of Alfa Laval – they are our core competences.



Broad product spectrum

Alfa Laval is one of the world's most experienced suppliers of the technologies and equipment central to the efficient production of fuel ethanol.

What distinguishes Alfa Laval is their expertise, which encompasses virtually the entire spectrum of heat transfer and separation equipment required to:

- bring new fuel ethanol plants on line at minimum cost and at maximum speed
- upgrade and expand existing fuel ethanol plants
- boost the capacity of existing installations, with only a minimum of changes
- increase revenues from any fuel ethanol process by providing reliability, improving performance and minimizing downtime.

Solutions for every requirement
Alfa Laval has the technological capability, practical know-how and high-performance equipment you need to make the most of every phase of your fuel ethanol processing.

Like no other supplier, Alfa Laval has developed a range of new products tailored for the ethanol industry. Therefore we can provide you with a wide selection of the equipment you need, from pre-treatment, fermentation and distillation to stillage, dewatering and evaporation.

One supplier that provides the complete range
"For us, it is very beneficial to deal with a supplier like Alfa Laval, since they have so many of our key components in their product portfolio. We appreciate the fact that we can turn to the same people for support whether it concerns a mash cooler, condenser, decanter or evaporator."
Peter Nimrodsson, Head of Maintenance, Agroetanol, Norrköping, Sweden

Our product range extends over the full spectrum of heat exchangers, condensers, evaporators, decanter centrifuges, disc-stack centrifuges, membrane filtration systems and tank cleaning equipment with designs specifically tailored to meeting the challenges of the industry.

Alfa Laval's equipment is based on proven components that are easy to use and cost-effective to implement in both new and existing production facilities.

One single-source provider
Alfa Laval's long-term dedication to serving the fuel ethanol industry and our experience and insight of industry needs ensure you the full benefit of an extensive resource of process knowledge – all from one single-source supplier.

You can rely on Alfa Laval's experience to select and combine the most efficient and reliable equipment for each stage of the process. You benefit from the time and hassle saved by working with one partner.

Sign of the times
Using Alfa Laval as a key equipment supplier for your fuel ethanol production facility ensures efficient supply chain management and optimized logistics.

You benefit from integrated, well-planned solutions that bring your ethanol production operations online as rapidly as possible.

And once installed, Alfa Laval's equipment is both easy to use and exceptionally reliable, which eliminates downtime and maximizes your return on investment.

In it for the long haul
Our obligations to you and your company do not stop with delivering the equipment and getting it running perfectly.

The Alfa Laval Parts & Service organization is always on call to ensure you peak performance and maximum output from your production process, with an absolute minimum of downtime throughout the service life of the installation.

This represents a long-term commitment to performance, reliability and service that Alfa Laval calls Nonstop Performance.

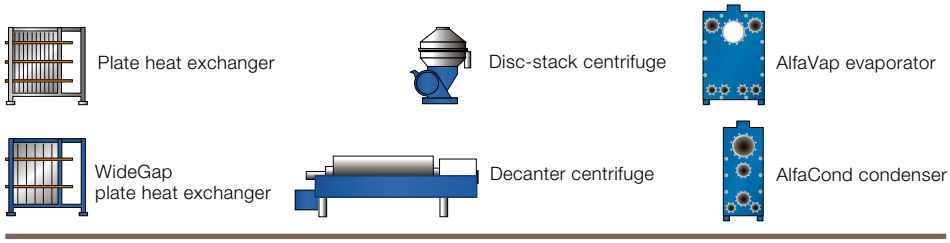
Practical know-how – available everywhere
With sales offices and service centres in more than 50 countries on every continent, Alfa Laval's expertise and resources are always close at hand.

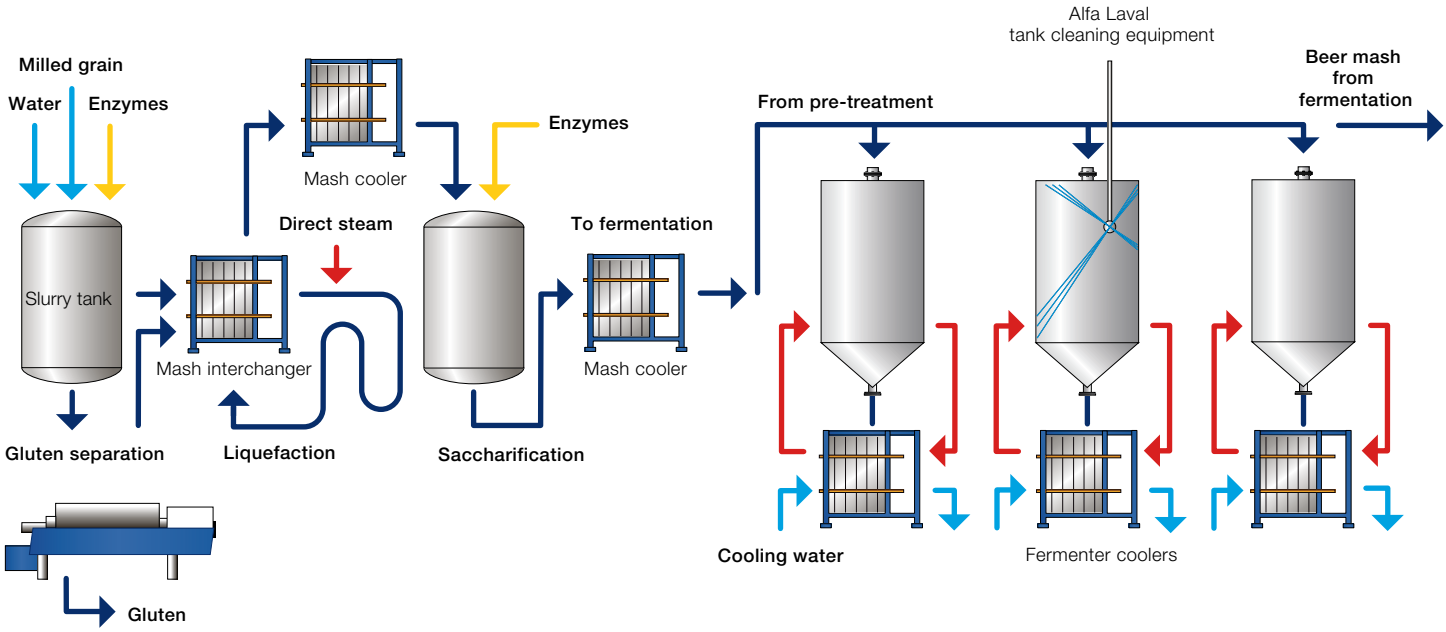
Experts are ready to help you with any material and processing challenges specific to your ethanol production process.

Our global network of experts is always on standby to meet your needs for technical support, spare parts and service – 365 days a year, around the clock.

"Working with Alfa Laval is, most of all, working in partnership. An experienced sales and technical staff guarantee that we find the right products for our needs. In the acquisition of equipment, we always search the market in order to find the best supplier in terms of product quality and efficiency – all of which we have found in Alfa Laval's products."
Mr. Gilberto Zanon, Operations Director, Usina Batatais, Brazil

Grain-based processing





Pre-treatment

Fermentation

This diagram illustrates where Alfa Laval's equipment can be installed for the production of fuel ethanol from corn or grain.

Pre-treatment

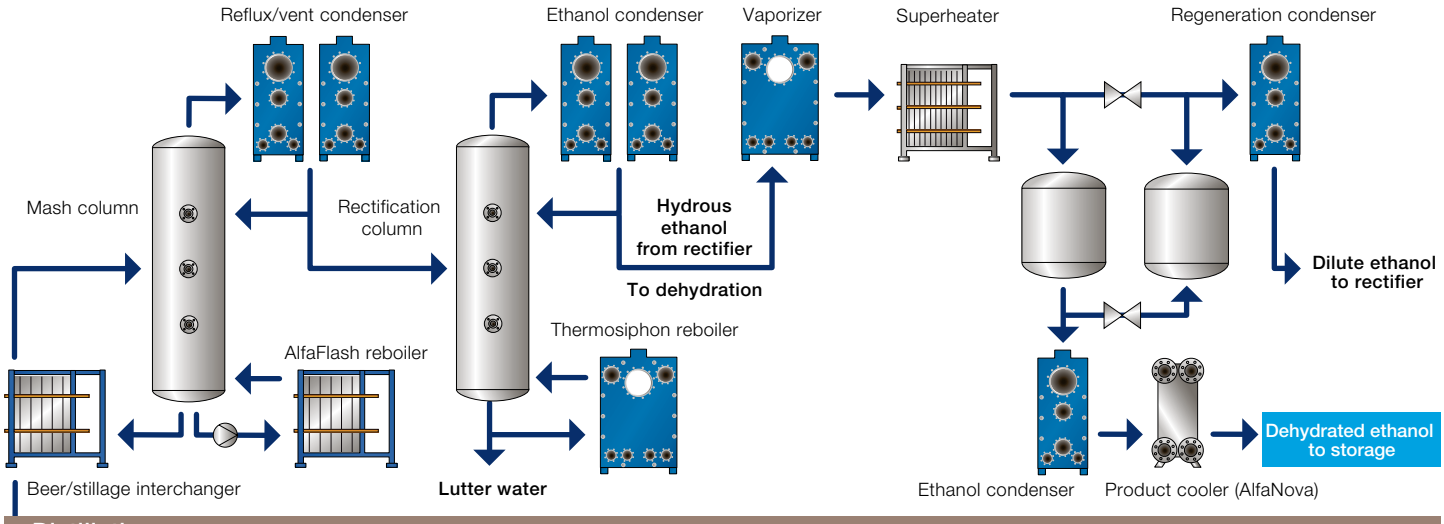
The milled grain is mixed with water and enzymes and then heated to liquefy the mash. This begins the conversion of starch to sugar. Alfa Laval WideGap plate heat exchangers cool the mash from 90°C (194°F) to fermentation temperature. The gluten protein phase can also be recovered using a special Alfa Laval process.

Fermentation

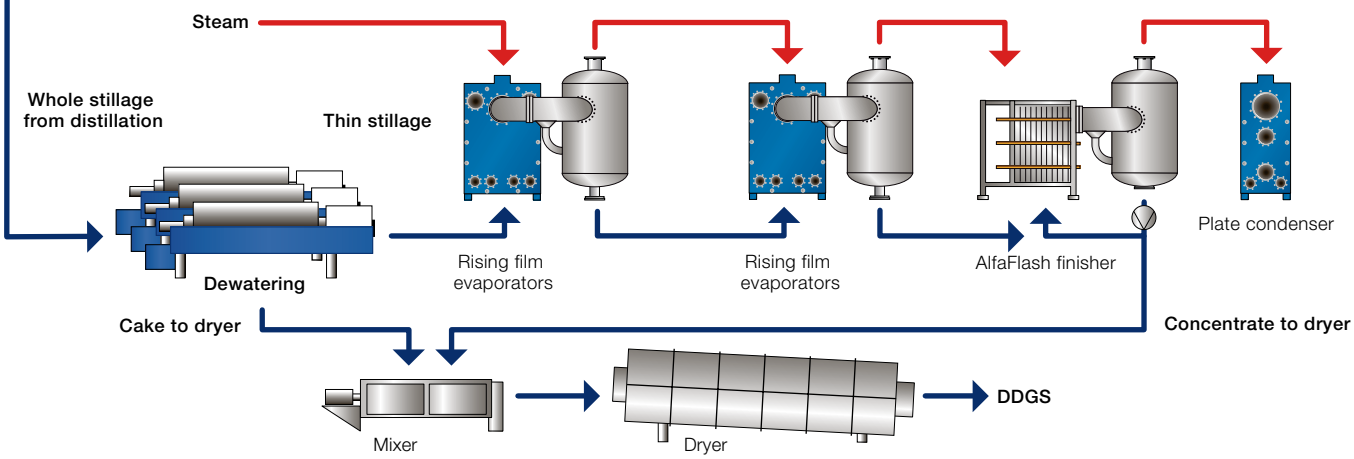
In fermentation, yeast converts sugar to ethanol. Alfa Laval's WideGap plate heat exchangers remove the heat generated by this process, ensuring complete fermentation and the beer mash at the optimum temperature.

Distillation/dehydration

After fermentation, a multi-column distillation system strips the alcohol from the beer. This hydrous alcohol then goes to dehydration. Alfa Laval heat exchangers are used as flash and



Distillation



Stillage

thermosiphon reboilers, condensers and liquid/liquid heat exchangers throughout the distillation and dehydration process.

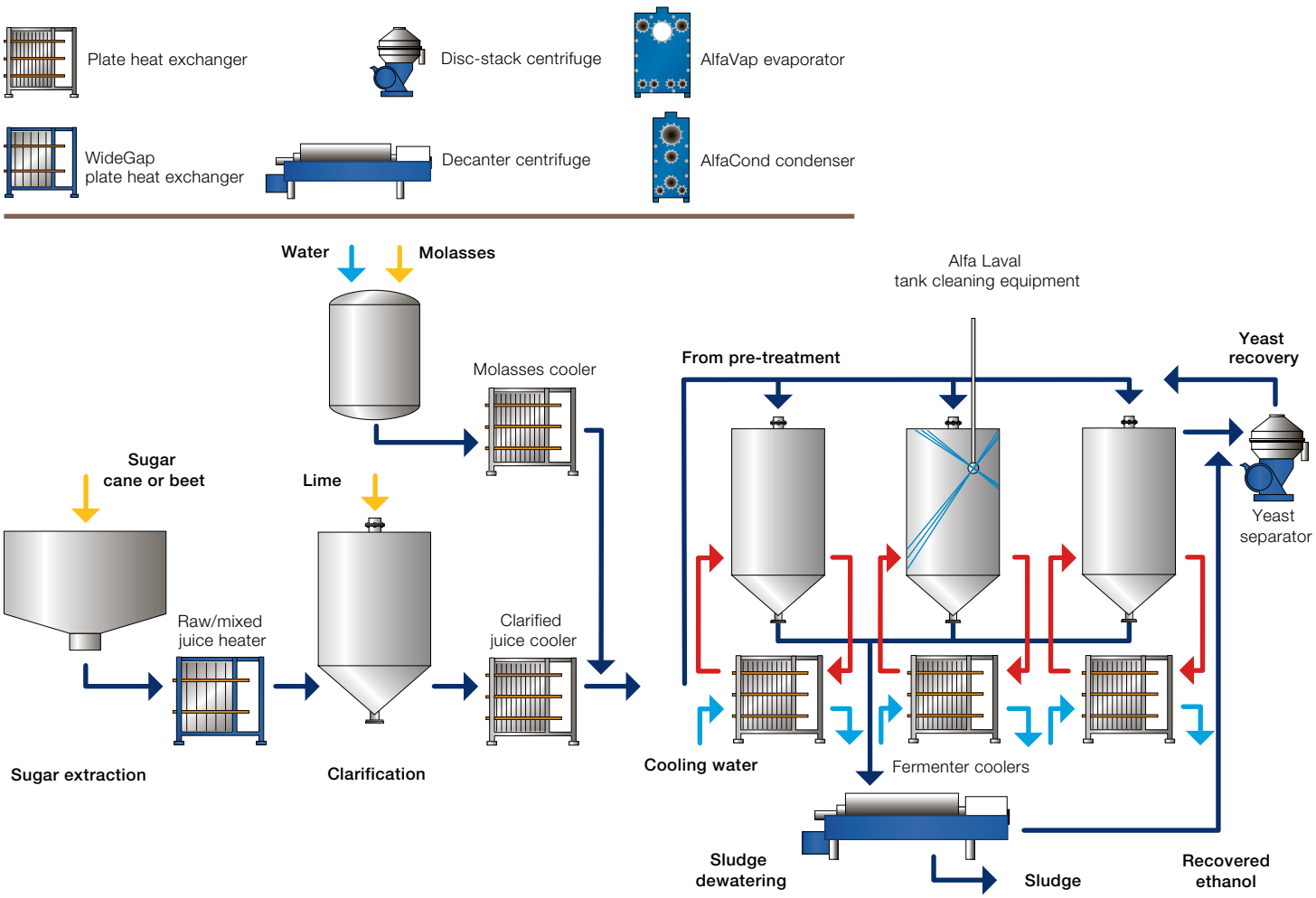
Stillage

Alfa Laval decanter centrifuges and plate evaporators are suitable for whole stillage dewatering and thin stillage concentration. Both the decanter cake (up to 40% dry solids) and the concentrated evaporator syrup (up to 40% dry solids) are dried to a final DDGS product.

Alfa Laval decanter centrifuges ensure maximum uptime and minimum maintenance. High solids recovery means that downstream evaporation operates more efficiently. Alfa Laval plate evaporators are an effective, compact alternative to the traditional technologies used for stillage evaporation.

Alfa Laval forced-circulation flash plate evaporators are also used as a finisher for greater syrup concentration.

Sugar-based processing



Pre-treatment

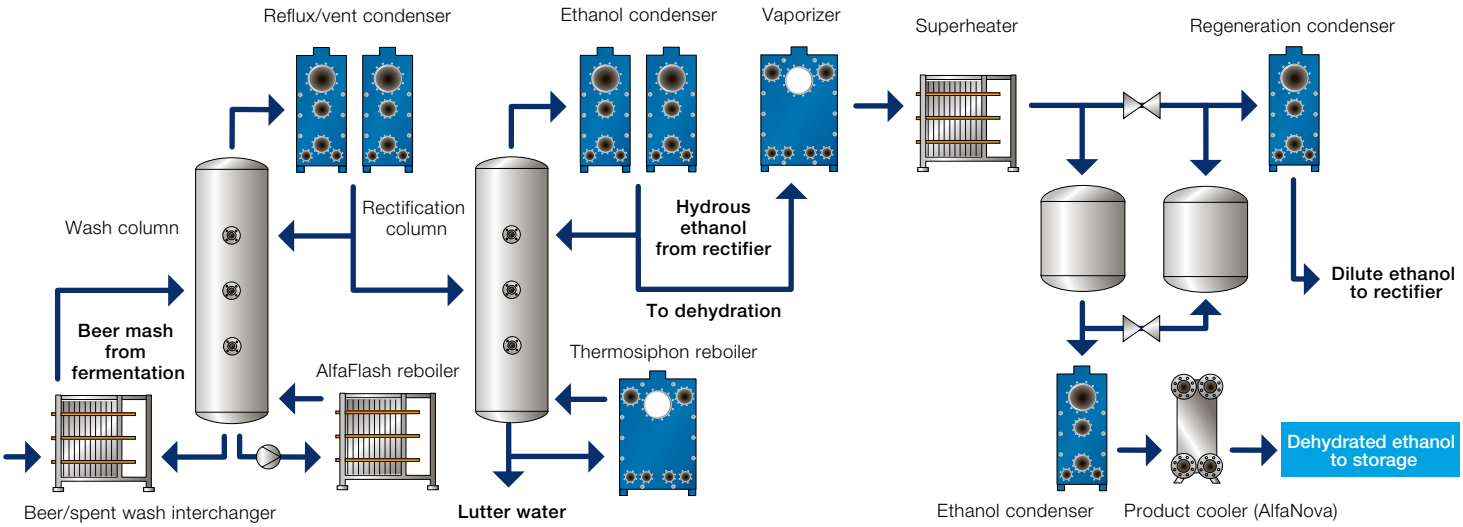
Fermentation

This diagram illustrates where Alfa Laval's equipment can be installed for the production of fuel ethanol from cane or beet.

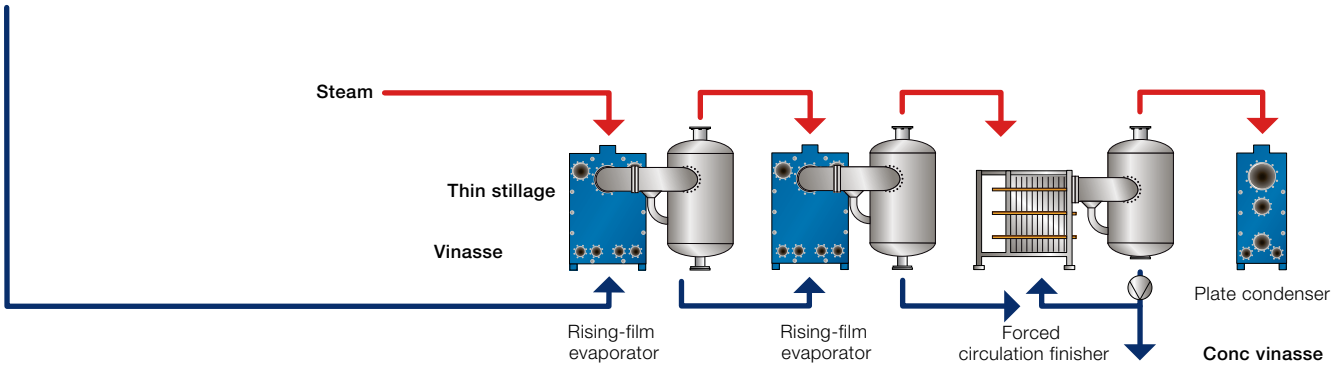
Pre-treatment
Sugar is extracted from sugar beet or cane. The raw/mixed juice is either used directly for fermentation or purified. Non-sugars and fibres in the raw/mixed juice are precipitated by adding lime and then removed in filters. Alfa Laval's WideGap plate heat exchangers are ideal for duties that contain fibres and other impurities in the raw juice.

Molasses is diluted to reach an optimum concentration for fermentation by adding water or by mixing directly with the sugar juice. Prior to fermentation, the molasses can be clarified using Alfa Laval disc-stack centrifuges and pasteurized to avoid bacterial infection. Alfa Laval plate heat exchangers are perfect for heating and cooling molasses.

Fermentation
In fermentation, yeast converts sugar to ethanol. The heat generated by this process can be removed by Alfa Laval plate heat exchangers so that complete fermentation is achieved.



Distillation



Vinasse

These Alfa Laval heat exchangers maintain the beer mash at an optimum temperature.To optimize yield, the yeast is separated from the beer after fermentation in an Alfa Laval disc-stack centrifuge. The yield can be increased further by dewatering the fermenter sludge using an Alfa Laval decanter centrifuge and then returning the recovered beer and ethanol to the fermentation process.

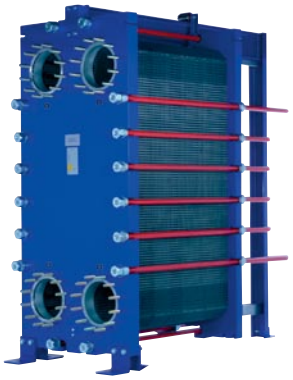
Distillation/dehydration

After fermentation, a multi-column distillation system strips the alcohol from the beer. This hydrous alcohol then goes to dehydration. Alfa Laval heat exchangers are used as flash and thermosiphon reboilers, condensers and liquid/liquid heat exchangers throughout the distillation and dehydration process.

Vinasse

Alfa Laval plate evaporators provide a compact alternative to traditional technologies for vinasse concentrations. Alfa Laval forced-circulation flash plate evaporators are then used as a finisher for increased vinasse concentration.

Everything you need – from one supplier



Alfa Laval provides systems and equipment for maximum efficiency and reliability in every phase of fuel ethanol production.

And in each specific area, from fermentation, separation and distillation to the final product, you'll reap the benefit of Alfa Laval's superior engineering. We know that reliable operation is the key to long-term commercial success and profitability.

Gasketed plate heat exchangers
Alfa Laval provides a complete range of gasketed plate heat exchangers featuring fully countercurrent flow and high turbulence.
These units provide maximum heat recovery with a minimum of capital investment and installation costs.

Typical uses: Alfa Laval plate heat exchangers are suitable as coolers and heaters of process media and other utilities in the ethanol production process.

Features
- Available in accordance with all major pressure vessel codes for design up to 30 barg (435 psig) / 180°C (355°F)
- Single-step pressing of plates ensures greater uniformity, reduced physical stress
- Low hold-up volume
- Design flexibility to meet specific requirements
- Easy access for cleaning and maintenance.

Benefits
- Low capital and installation costs
- Compact design means easy installation
- Close temperature approach results in increased energy savings
- High-turbulence flow minimizes fouling
- Full access to the heat transfer surfaces keeps service and maintenance costs to a minimum
- Easily expandable for increased production rates.

WideGap plate heat exchangers
WideGap plate heat exchangers are specially designed to handle fibrous liquids and liquids that contain large amounts of suspended solids.
The design combines the benefits of compact, efficient plate heat exchangers with a special plate pattern and port design that help prevent fouling.

Typical uses: Cooling mash to fermentation temperature and removing heat generated in the fermentation process.

Features
- ASME and PED-coded design for up to 10 barg (150 psig) / 180°C (355ºF)
- Single or double wide-gap design with up to 17 mm (2/3-inch) channels free of contact points
- Special non-fouling port design
- Up to 350 mm (14 inches) ports allowing flow rates of up to 1,800 m^3/hr (8,000 gpm)
- Easy access for cleaning and maintenance.

Benefits
- Can handle fouling media in either one or both channels
- Can handle very large volumes and heat loads in one unit
- Easily expandable for increased production rates
- Close temperature approach results in increased energy savings
- Provides the benefits of high thermal performance and compact solutions for fibrous and fouling media.

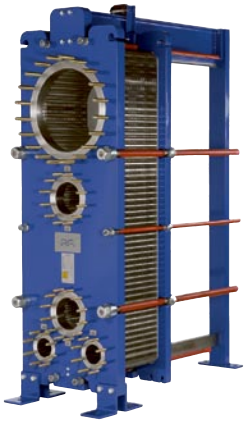


Plate condensers

AlfaCond plate condensers are specially designed for condensing duties. They combine the benefits of compact, efficient plate heat exchangers with the low pressure drop required for condensing.

Typical uses: Condensing ethanol vapour from the distillation column and the vapour from stillage evaporators.

Features
- ASME and PED-coded for design pressure of up to 6 barg (85 psig) (cold side) / 8.6 barg (125 psig) (hot side) and design temperature up to 160°C (320ºF)
- Special plate design optimizes condensing and is also ideal for vacuum condensing
- High heat transfer coefficients
- Easy access to the cooling water side
- Fully countercurrent design helps sub-cool non-condensable gas.

Benefits
- Low capital and installation costs
- Compact design means easy installation
- Close temperature approach results in increased energy savings
- High-turbulence flow minimizes fouling
- Easily expandable for increased production rates.

Plate evaporators

AlfaVap plate evaporators are specially designed for evaporation duties. They combine the benefits of compact, efficient plate heat exchangers and can handle small temperature differences between the hot and cold side.

Typical uses: As reboilers in distillation columns and as evaporators for the stillage.

Features
- ASME and PED-coded for design pressure of up to 6 barg (85 psig) (cold side) / 8.6 barg (125 psig) (hot side) and design temperature up to 160°C (320ºF)
- Superior heat transfer coefficients
- Up to 2,000 m^2 (21,000 ft^2) of heat transfer area in a single unit
- Modular design.

Benefits
- Low capital and installation costs
- Compact design means easy installation
- Easily expandable for increased production rates and capacity increases
- Close temperature approach for increased energy savings.

Spiral heat exchangers

Alfa Laval spiral heat exchangers feature a single-channel design that results in a self-cleaning effect. They are particularly suitable for processes where fouling can be a problem, such as in handling sludges, fibrous liquids or solids in suspension, as well as a wide range of viscous fluids.

Typical uses: Cooling mash involving particularly difficult media or high design pressures.

Features
- ASME and PED-coded for design up to 40 barg (580 psig) / 400°C (750ºF)
- Spacing on both hot and cold sides available up to 25 mm (1 inch) with heat transfer area of up to 700 m^2 (7,000 ft^2)
- Single channel – "what goes in must go out".

Benefits
- Can handle fouling media in one or both channels
- Compact design means easy installation
- Countercurrent design allows close temperature approach, resulting in greater energy savings
- Easily accessible for cleaning and inspection
- Wide channels reduce fouling and result in increased uptime.

Compabloc fully welded plate heat exchangers

Alfa Laval Compabloc heat exchangers are fully welded, which means no gaskets are needed between the plates. Compablocs are ideal for use with chemically aggressive fluids and for duties featuring high pressure and/or high temperature.

Typical uses: As condensers and reboilers in the distillation column for high-temperatures and high pressure duties.

Features
- ASME and PED-coded design for up to 35 barg (500 psig) / 350°C (660ºF)
- Corrugated plate pattern that ensures optimized flow
- Superior heat transfer coefficient
- Up to 330 m^2 (3,500 ft^2) of heat transfer area.

Benefits
- Extremely compact, thus saving on capital and installation costs
- Ideal for reboiler and condenser duties, due to the low pressure drop and high heat transfer coefficient
- Nozzles and pass configurations can be customized to meet particular requirements.

Fusion-bonded plate heat exchangers

AlfaNova fusion-bonded plate heat exchangers are gasket-free. They are ideal for process media where compability with gaskets would be a problem. They are also well-suited for high-pressure and high-temperature duties.

Typical uses: Cooling clean products such as ethanol and fusel oils.

Features
- ASME and PED-coded design for up to 30 barg (435 psig) / 550°C (1,000ºF)
- Corrugated plate pattern that ensures optimized flow
- Superior heat transfer coefficient
- Made of 100% stainless steel
- No gaskets.

Benefits
- Very economical when used at high temperatures and pressures
- Plate design allows close temperature approach for increased energy savings
- Provides the high thermal efficiency and compactness of a plate heat exchanger where temperature, pressure or media does not allow gaskets.

Disc-stack centrifuges

Alfa Laval disc-stack centrifuges are highly efficient separation units ideal for duties involving small particles such as yeast, with medium concentrations of solids. They are also used for separation of immiscible liquids such as oil and water.

Typical uses: Separation and recycling of the yeast from the beer prior to distillation. Separation of corn oil from stillage.

Features
- Superior wear protection
- Easy to service
- Replaceable wear parts
- Available as fully automated integrated modules.

Benefits
- Extensive range ensures an effective fit for all duties
- Low operation costs due to fully automatic systems that do not require manual supervision
- Alfa Laval service and maintenance programes ensure maximum production uptime
- Long service life and high utilization.

Decanter centrifuges

Alfa Laval decanter centrifuges provides a high efficiency dewatering for high solid concentration fluids.

Typical uses: Separation of solid particles from the stillage, prior to evaporation.

Features
- Feed zone design tailored for stillage
- Replaceable wear protection on conveyor and feed zone
- Heavy-duty planetary Direct Drive gearbox
- 360-degree solids discharge
- Compact modular construction
- Unique internal design.

Benefits
- Low energy consumption
- Superior cake dryness and centrate clarity
- Long service life for wearing parts, resulting in better utilization of equipment
- Lower installation and maintenance costs due to compact design and fewer parts.

Tank cleaning equipment

Alfa Laval rotary jet heads clean tanks by circulating jets of cleaning media in a criss-cross pattern that impacts the entire inner surface of the tank.

Typical uses: Cleaning the fermenters after each batch to prevent contamination.

Features
- Complete coverage and effective, high-impact cleaning that boosts hygiene
- Uses only small amounts of water and chemicals to achieve the required cleaning effect
- Consistent, reproduceable cleaning results.

Benefits
- Reduced consumption of water and biocides helps minimize environmental impact
- Moderate investment with rapid payback
- Easy to handle, service and maintain
- Ensures less downtime, rapid tank turnaround and best possible conditions for subsequent production batches.

Membrane filtration systems

Alfa Laval is Europe's largest developer and manufacturer of flat sheet membranes. We supply a complete spectrum of cross-flow filtration technologies, from microfiltration to reverse osmosis.

Typical uses: Polishing stillage from solids, stillage dewatering and grain pre-treatment.

Features
- Enables separation based on molecular size, with no additives needed
- Wide range of polymeric membrane configurations
- Modules available in plate-and-frame and spiral configurations
- End-to-end control and supervision of quality standards.

Benefits
- Reduces effluent flow and helps minimize environmental impact
- Low energy consumption compared to dryers and evaporators
- Consistent quality and reliability in operation with long lifetime.

Energy efficiency

Focus on improvement
In past decades, the ethanol industry has undergone substantial transformation – from relatively small-scale production of high-value potable alcohol to the production of low-margin fuel-grade ethanol on a very large scale. This has accelerated the drive to improve production processes and find more cost-effective solutions for each stage of the distillery process.

Areas for potential savings:
- improving energy efficiency in the pre-treatment stage by interchanging heat
- improving both condenser and reboiler equipment
- exploiting new membrane filtration technology for separation duties
- boosting fermentation efficiency through the use of advanced tank cleaning equipment.

Interchanger improvements
During pre-treatment in a grain-based process, a substantial slurry steam needs to be heated and then cooled. Using interchangers in which hot liquefied mash is used to heat incoming cold mash results in significant energy savings.

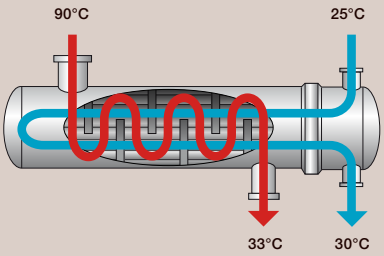
A shell-and-tube heat exchanger cannot heat the cold side liquid to a temperature higher than that of the outlet temperature of hot side liquid, which results in limited heat recovery.

A plate heat exchanger, on the other hand, where the fluids flow fully countercurrently can heat the cold liquid to a temperature very close to that of the incoming hot liquid. Hence it is well-suited for heat recovery.

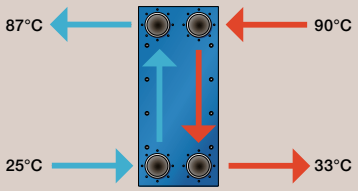
Alfa Laval's WideGap models are ideal for heat recovery between hot and cold mash as well as for between fermented beer and stillage. They feature fully countercurrent flow and are available with double-sided wide-gap plates which ensure trouble-free operation.

Two-phase improvements
Condensers and reboilers based on purpose-built high-efficiency plate heat exchanger technology, such as AlfaVap and AlfaCond, have demonstrated their technical superiority in many ethanol production installations.
They feature:
- heat transfer up to 300% more efficient than traditional shell-and-tube condensers
- efficient sub-cooling of non-condensable inerts, thus minimizing the need for secondary condensers
- a very compact design and a low weight which means they can be mounted in a wide range of previously inconceivable locations.

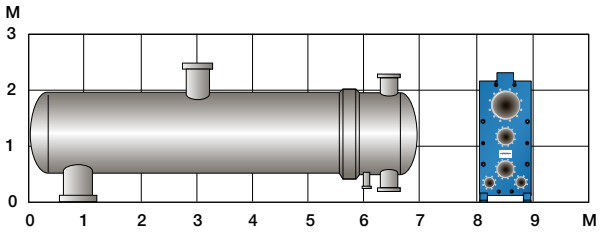
These units can be used as column reboilers, dehydration condensers and reflux condensers.



In a tubular heat exchanger, the cold liquid can't reach a temperature higher than that of the hot liquid outlet.



A plate heat exchanger has fully countercurrent flow and is superior in heat recovery duties.



Space required by an AlfaCond and a comparable shell-and-tube heat exchanger.

Separation efficiency

New generations of decanter centrifuges
Recent advances in decanter centrifuge technology have resulted in the SG2 decanter series designed for spent grain dewatering. These advances now make it possible to boost virtually all the parameters of separation performance.

The new SG2 series provides maximum G force and specially designed feed zones and pond and discharge areas. These decanters operate under stringent control, resulting in a low moisture cake. They have the ability to recover a higher degree of suspended solids, while using less energy and reducing overall operating costs.

The benefits of membrane filtration
Membrane filtration is a technology currently gaining ground in fuel ethanol production as a result of developments in both process configurations and membrane materials.

Proven uses include the recovery of pure water from side streams such as evaporation condensate, removing water from stillage, and the production of clearer thin stillage.

Membrane filtration technology provides a broad spectrum of solutions for optimizing water balances throughout the plant, thereby reducing the environmental impact and boosting the bottom line result.

”We have been very impressed with the performance of our Alfa Laval Decanter centrifuges both from the process performance standpoint, as well as the mechanical reliability standpoint. When we expanded it was an easy choice to continue with Alfa Laval”.
Dwayne Braun, General Manager, US Bio Platte Valley, Central City, Nebraska, USA

Completing the picture
One of the many advantages of using Alfa Laval’s key equipment for fuel ethanol production is that a single-source supplier can ensure the effective integration and coordination of the different phases of production in order to yield the maximum benefit. Alfa Laval tank cleaning equipment helps complete this picture.

That’s why Alfa Laval is the company to talk to when you’re looking for an effective partner to optimize any process for fuel ethanol production.

Alfa Laval tank cleaning machines offers complete coverage and effective, high-impact cleaning that boosts hygiene.

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