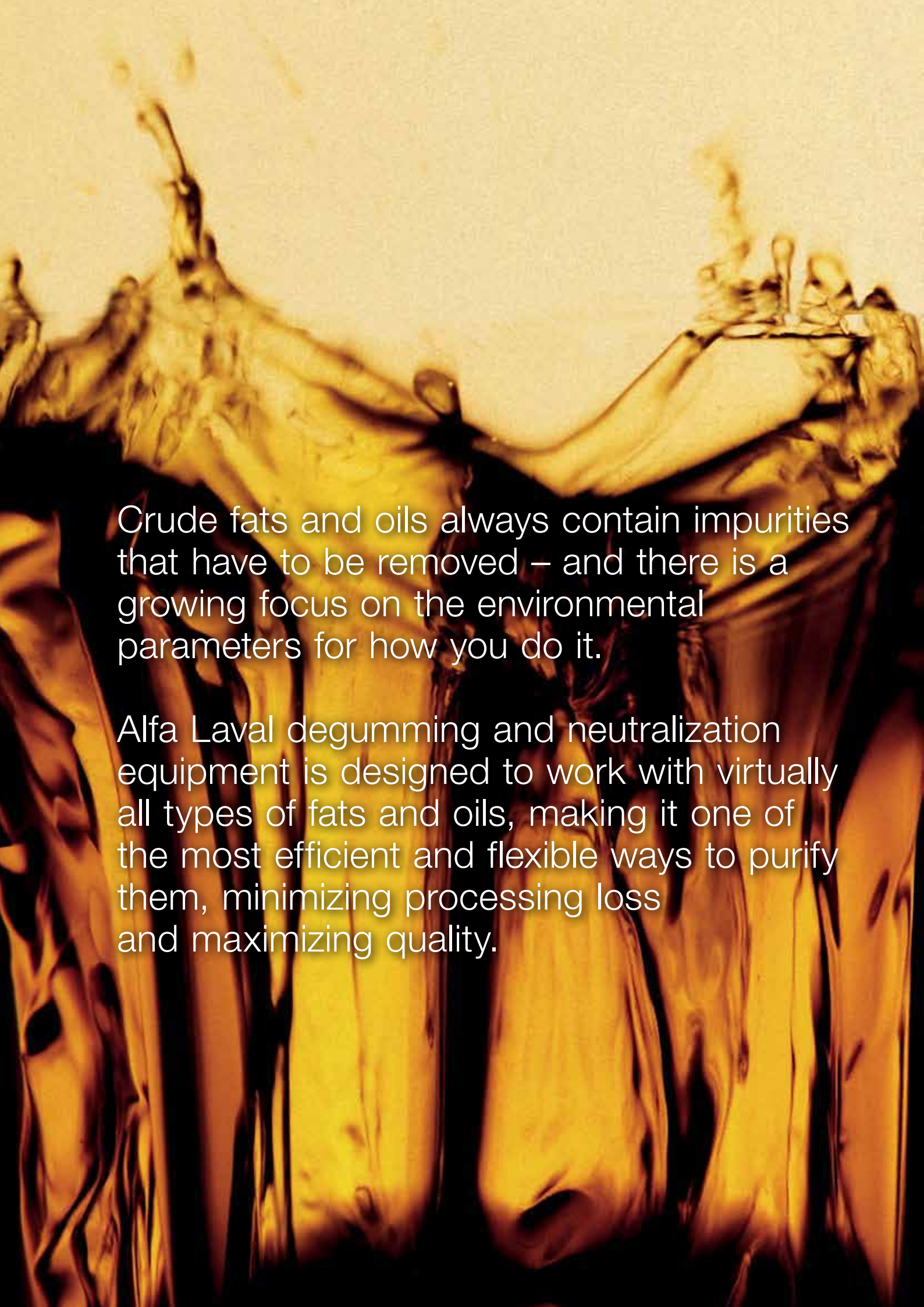
Edible Oil Refining Process Systems

Alfa Laval degumming and neutralization solutions



Crude fats and oils always contain impurities that have to be removed – and there is a growing focus on the environmental parameters for how you do it.

Alfa Laval degumming and neutralization equipment is designed to work with virtually all types of fats and oils, making it one of the most efficient and flexible ways to purify them, minimizing processing loss and maximizing quality.

Make the best start

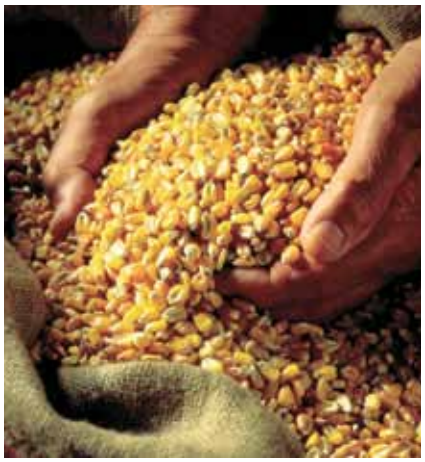
Dealing with impurities
Most crude fats and oils contain impurities that must be removed early on so that further processing can take place.

These impurities can include:
- solid particles (such as dirt)
- gums
- free fatty acids
- pigments
- substances that affect smell and taste.

The one single technology that plays the most important role in removing such impurities from both animal and vegetable fats and oils is separation.

Separation is crucial in ensuring the desired product quality, and the way it is done must comply with increasingly stringent environmental regulations throughout the world.

Your advantage here is that Alfa Laval is one of the world's leading suppliers of separation equipment of virtually all kinds, with more than a century of experience in this field.



Flexible response
Alfa Laval degumming and neutralization equipment is designed to ensure you maximum flexibility in your fats and oils processing and refining operations.

We can provide an extensive range of high-efficiency disc stack centrifuges, plate heat exchangers and mixers, specially developed for use in refining fats and oils. All such equipment is available either as stand-alone items, as modular installations or as part of a complete processing system.

The modular design of Alfa Laval fats and oils processing equipment also makes it ideal regardless of whether you are retrofitting or expanding existing installations, or setting up a new processing operation.

The raw materials
Alfa Laval equipment is widely used for processing and refining fats and oils of all kinds.

The most common raw materials are:
- soybean
- rapeseed/canola
- oil palm
- sunflower seed
- maize/corn
- cottonseed
- peanut/groundnut
- animal fats (including fish oil, tallow, etc.).

Many paths to purification

The initial stages
Once the initial stages of pre-treatment, pressing and extraction are complete, the process of refining the raw material begins. This normally consists of four stages – or five, if the feed contains waxes:

- degumming
- neutralization
- bleaching
- dewaxing/winterization (only for oils containing waxes)
- deodorization.

Physical or chemical?
Two basic types of refining are normally used to process fats and oils – physical and chemical. Each approach has its own specific advantages, and the use of one or the other depends heavily on the quality and the type of oil involved.

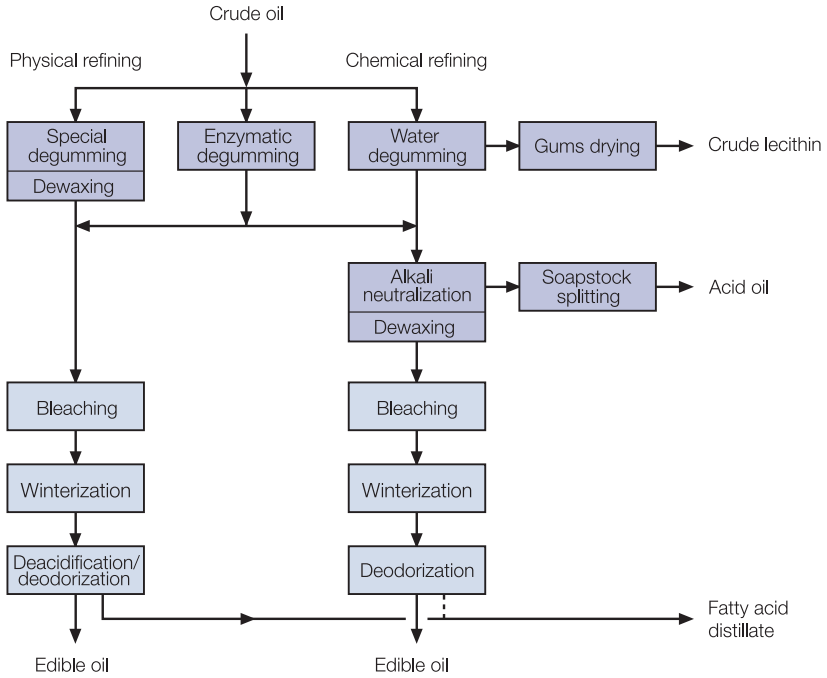
In physical refining, the free fatty acids in the oil are removed using multi-stage stripping during the deodorization process. Physical refining normally has the following general characteristics:

- can only be used with certain, limited types of crude oils – for example palm oil, but not cottonseed oil or fish oil
- depends on efficient degumming prior to refining
- is largely effluent-free, providing a better environmental profile
- avoids producing soapstock requiring subsequent treatment, and thus involves relatively low production costs.

In chemical refining, caustic soda is used to neutralize the free fatty acids in the oil, in a chemical reaction. This more traditional kind of refining normally has the following characteristics:

- can be used with a wider variety of crude oils, including soybean, sunflower seed and rapeseed oil
- results in a product that is more chemically stable and therefore has a longer shelf life
- results in the production of soapstock that needs expensive subsequent treatment and disposal, and thus involves relatively high production costs.

Based on both operating costs and environmental priorities, a gradual transition is currently taking place from chemical refining to physical refining, as and when technology permits.



Pretreatment for both edible oils and biodiesel
The processes used to refine edible fats and oils are very similar to the pretreatments that remove impurities from the feedstocks used to manufacture biodiesel.

This means such pretreatment process lines can be suitable for both edible oil feedstock and biodiesel. There are two alternative pretreatment processes:

- degumming for use when the removal of free fatty acids is not required
- alkali neutralization for removing free fatty acids and gums.

Dewaxing/winterization can be added if needed.

The power behind the processes

Benefit from experience
One of the key advantages of working with Alfa Laval to install, update and extend your fats and oils refining equipment is our wide-ranging practical experience.

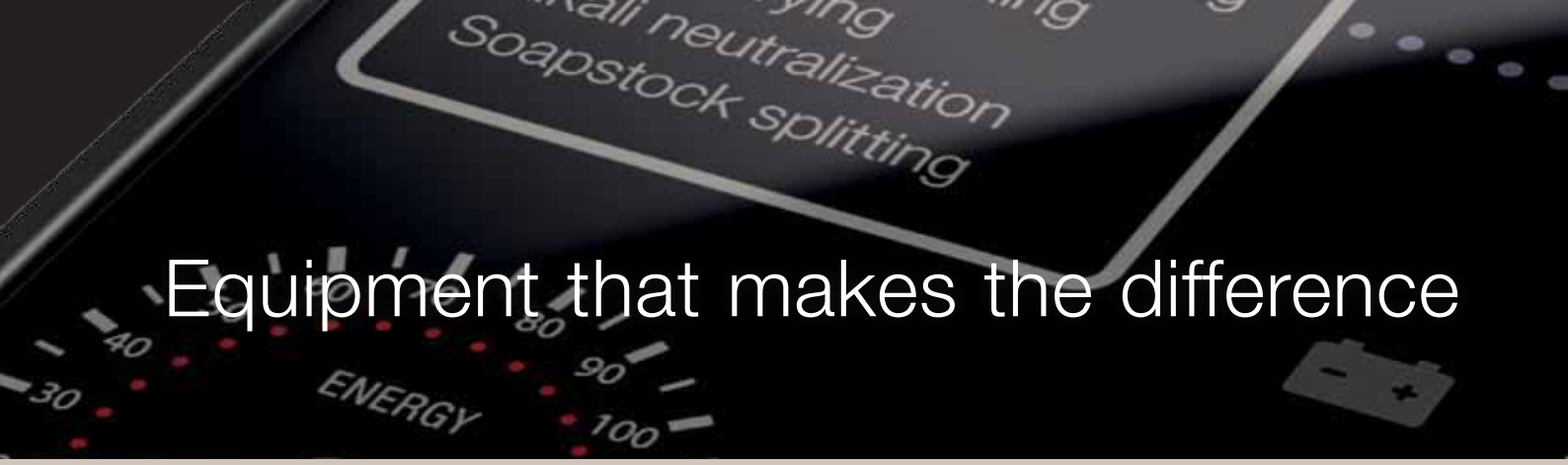
You benefit from our vast body of accumulated know-how, with constant access to the most recent technologies and solutions implemented by Alfa Laval all over the world.

The automation advantage
The automation of key plant operating processes – either wholly or in part – means you can undertake rapid, reliable re-settings and adjustments to meet new specifications. This enables you to achieve new levels of flexibility and profitability.

Alfa Laval supplies a wide range of easy-to-operate control and monitoring systems that are also easy to integrate into existing plant control systems. We can provide you with the exact degree of automation you need to meet your particular requirements.

Engineering services
We also provide a wide range of supplementary engineering services that can help you make sure your new installation comes on line as quickly and efficiently as possible – with considerable savings. This includes ensuring full compliance with the relevant national and international regulations for design codes, safety procedures and best engineering practice.

Alfa Laval engineering services include:
- installation design to comply with both national and international standards
- effective installation supervision
- commissioning and start-up
- operator training
- comprehensive documentation
- carefully planned spare parts packages
- quick-response operational, maintenance and service support.



Equipment that makes the difference

Disc stack centrifuges
The Alfa Laval range of disc stack centrifuges consists of units with capacities ranging from 50 t/day up to 1,500 t/day.

For example, the extensive PX range of disc stack centrifuges features semi-hermetic technology and is equipped with the unique Alfa Laval Centrizoom™ adjustable paring disc. This enables you to deal with a wide range of gums and soapstocks, and undertake rapid, variable adjustment via remote control. It also reduces energy consumption dramatically.

A solid bowl range of disc stack centrifuges is also available, featuring a hermetically sealed design. This protects the product against oxidation, which helps ensure high quality.

The hermetically sealed, bottom-fed inlet ensures gentle, non-destructive acceleration of the feed up to full bowl speed. This improves separation efficiency and minimizes power consumption.

Alfa Laval supplies disc stack centrifuges with a range of different drive systems:

- traditional gear-drive and belt-drive systems that provide well-proven reliability and efficiency
- innovative eDrive™ direct drive system. Compared with traditional solutions, this provides additional energy savings and longer service intervals.

Mixers
Adding the correct types of reagents in the right quantities is important, but correct mixing is crucial for the efficiency of the subsequent refining processes.

Alfa Laval has long-term practical experience in dealing with a wide range of mixing requirements, from the gentle “hydration” mixing in the degumming process to the high-intensity mixing required in the Alfa Laval Multi Mix process.

The MX range of mixers is designed on the basis of the MicroMerge™ concept. This features separate chambers for dispersion and mixing to ensure effective mixing and the most efficient utilization of additives. Combined with a frequency control drive, this gives you unparalleled flexibility in all mixing duties.

Plate heat exchangers
Alfa Laval plate heat exchangers are designed to make heat transfer more energy-efficient. The corrugated plates provide the largest possible surface area through which the heat can pass from one gas or liquid to another medium. This substantial heat transfer area is available within a relatively compact footprint.

The design of the channels also provides maximum turbulence, which ensures peak efficiency in transferring thermal energy from one medium to the other.

Alfa Laval plate heat exchangers have the added advantage that completely standard units are normally fully capable of handling all requirements within the fats and oils industry.

Evaporators and condensers
All the technical advantages of Alfa Laval plate heat exchangers are also available in AlfaVap and AlfaCond semi-welded units, specially designed for evaporation and condensation duties, respectively.

AlfaVap evaporators are especially efficient at high concentrations and viscosities, and can work with temperature differences of as little as 3–4°C (37–39°F). This is a big advantage in mechanical or thermal vapour recompression systems (such as wastewater evaporation systems).

AlfaCond condensers are tailored to achieve the most efficient vacuum condensation under all conditions. Their unique configuration and plate pattern make it possible to maximize heat transfer efficiency and minimize fouling as well as maintaining a low load on the vacuum system.

Scraped-surface heat exchangers
Convap evaporators and Contherm® scraped-surface heat exchangers are specially designed for concentrating and cooling particularly viscous, heat-sensitive products such as lecithin.

The unique construction of these heat exchangers, in which the product is continuously scraped off the wall, ensures constant transfer of heat and uniform distribution. This prevents any burn-on effects and helps ensure a product of consistently high quality.

Degumming – every which way

Removal is necessary
All fats and oils contain gums, or gum-like material. These consist largely of different carbohydrates, proteins and nitrogen compounds, and can be divided into hydratable and non-hydratable gums.

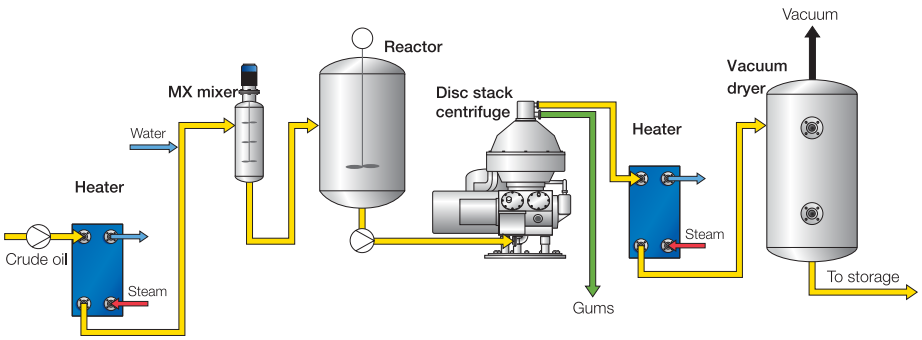
If these are not removed before the fat or oil is exposed to the high temperatures used in deodorization or deacidification/deodorization, quality problems can well emerge. This is because the gum can give rise to problematic emulsions that in turn result in a significant waste of oil that could otherwise provide revenue.

Water, chemicals or enzymes
These gums can be removed using either water degumming, other specialist degumming and special degumming processes.

Hydratable gums can be removed using water, because they absorb water and then become insoluble in oil. They are then removed using centrifugation.

Non-hydratable gums, on the other hand, are normally removed using a form of acid hydrolysis or caustic soda neutralization – phosphoric acid is the most common because it is the most cost-effective. Adding such acids also helps remove any trace metals by making them form insoluble complexes.

Water degumming



Alternatively, both hydratable and non-hydratable gums can be removed using enzymes. The enzyme that reacts specifically with phospholipids in oil is called phospholipase.

Water degumming
All seed oils contain hydratable gums, but oil derived from soybeans contains most.

Because soybean oil has a high content of hydratable gums, this is where water degumming is most commonly used. The gums removed with this process are normally dried to form lecithin, which is a valuable by-product. If preferred, the gums can instead be returned to the meal in the extraction plant.

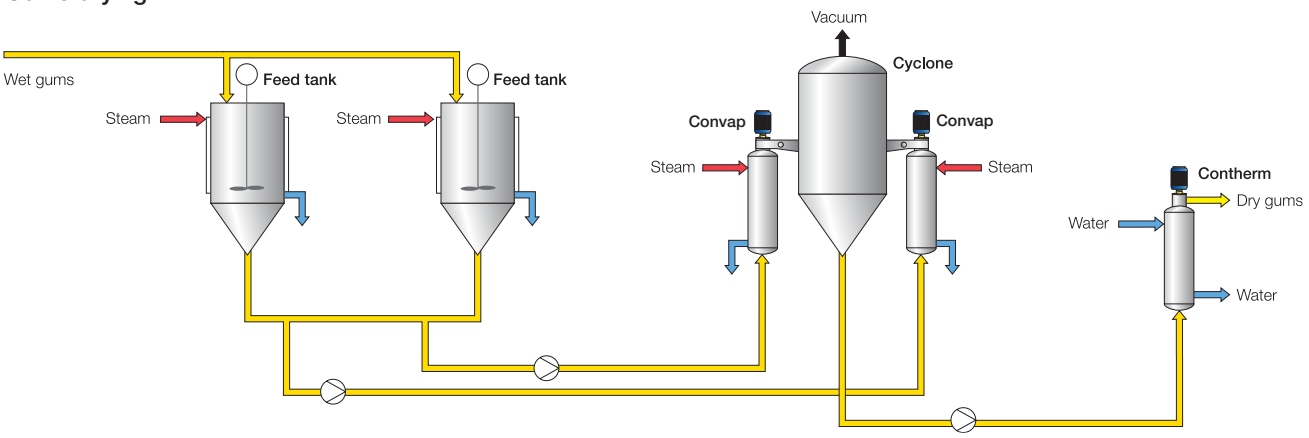
Water degumming has an important additional advantage that also makes it attractive in many other contexts. Using this relatively simple, cheap process to remove as much gum as possible in the initial stages, less material needs to be removed later on using neutralization. This also means there is less soapstock for treatment or disposal.

The Alfa Laval advantage
Using Alfa Laval equipment and technologies enables you to:

- ensure a lower gum content
- reduce losses of neutral oil
- increase oil yield
- cut down on operating costs.

Boosting the value of by-products

Gums drying



Lecithin – valuable by-product

When gums are removed from edible oils (such as soybean, rapeseed or sunflower seed oil) during the degumming stage, they are in the form of wet gums with a moisture content of 40–50%.

When dried, these gums become liquid lecithin, which can provide an important source of additional revenue.

Drying the gums

These wet gums are homogenized and then fed to Convap evaporator units. Here the moisture is evaporated using steam injected into the Convap jacket.

The lecithin is then separated from the vapours in a large cyclone, under vacuum, before being sent to Contherm heat exchanger(s) for cooling with water.

Quality benefits

The Convap evaporator and the Contherm cooler are both scraped-surface heat exchangers that are specially designed for concentrating and cooling viscous, heat-sensitive products such as lecithin.

As the lecithin only remains within the Convap evaporator for a very short time, it undergoes a very brief period of heat treatment, thus helping maintain product quality.

In contrast to thin-film evaporators, the heat transfer surface of a Convap unit is scraped thoroughly to prevent the product sticking and causing burn-on.

The unique construction of these Alfa Laval scraped-surface exchangers makes sure the product is uniformly distributed within the evaporator and the cooler, resulting in a product yield of consistently high quality.

Flexible operation

To reach the desired capacity, Convap and Contherm units are often installed with 2 or 4 units in parallel.

Any reductions in throughput, whether temporary or not, mean the extra units can be turned off, thereby reducing operating costs while maintaining stable product quality.

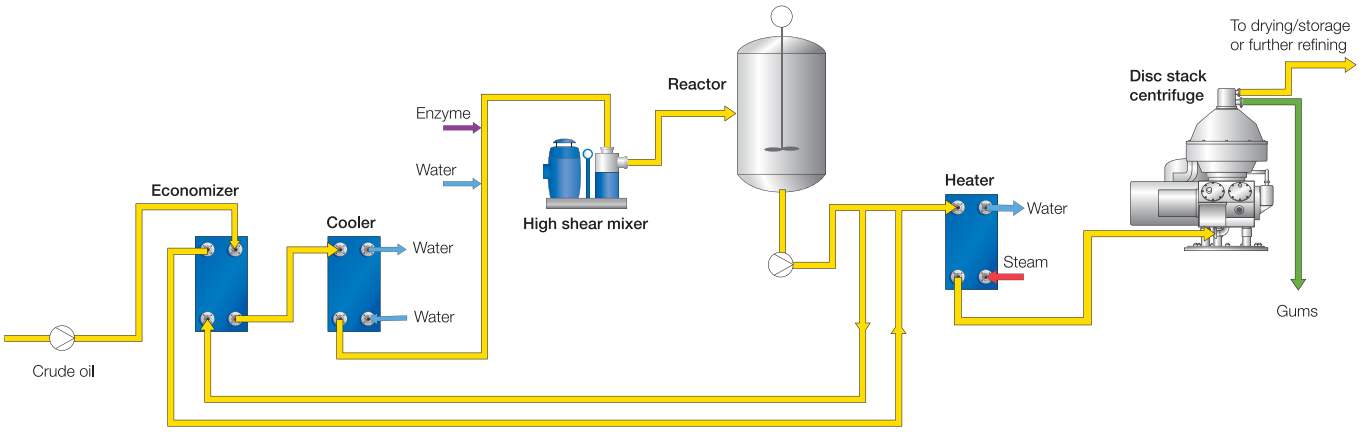
The Alfa Laval advantage

Using Alfa Laval equipment and technologies enables you to:

- ensure uniform heat distribution
- reduce thermal impact on oil products
- increase operating flexibility
- make operation and maintenance easier.

Enzymatic treatments

Enzymatic water degumming



Biological catalysts

Any gums present in the oil can also be removed by using enzymes. Enzymes are biological catalysts that react specifically with target substrates, with the added advantage that they yield few by-products.

Phospholipase is the enzyme that reacts specifically with the phospholipids in oil. It converts gums into distinct fractions that are soluble in oil and water, respectively. The phospholipases most commonly used in oil degumming are phospholipase A (PLA) and phospholipase C (PLC).

Enzymatic water degumming

Phospholipids are emulsifiers that cause losses of oil during the traditional water degumming process. Phosphatidylcholine (PC) is the most hydratable phospholipid and has the highest emulsification strength.

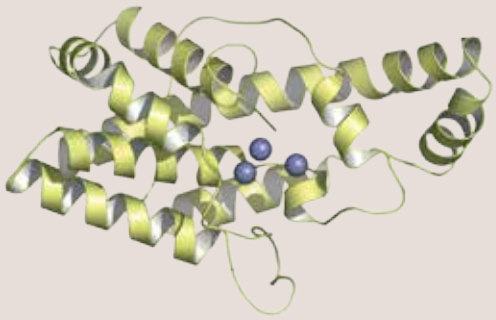
The PLC enzyme reacts with PC and phosphatidylethanolamine (PE), forming diacylglycerols and a water-soluble phosphate-bearing ester fragment, thus reducing the final emulsion. This results in cleaner separation during centrifugation, and also reduces losses of the neutral oil. In addition, the diacylglycerols produced by PLC degumming provide a bonus oil yield that is retained throughout the refining process.

Since PE is a non-hydratable gum, the oil usually has a lower gum content after PLC degumming compared with the water degumming process. This means less material that requires removal in subsequent processes.

Keeping options open

Alfa Laval provides an optimized degumming solution that focuses on increasing the oil yield and reducing utilities consumption.

The Alfa Laval enzymatic water degumming process has the added advantage that it can always be switched back to the traditional water degumming process if changing market conditions make lecithin production a more commercially attractive option.

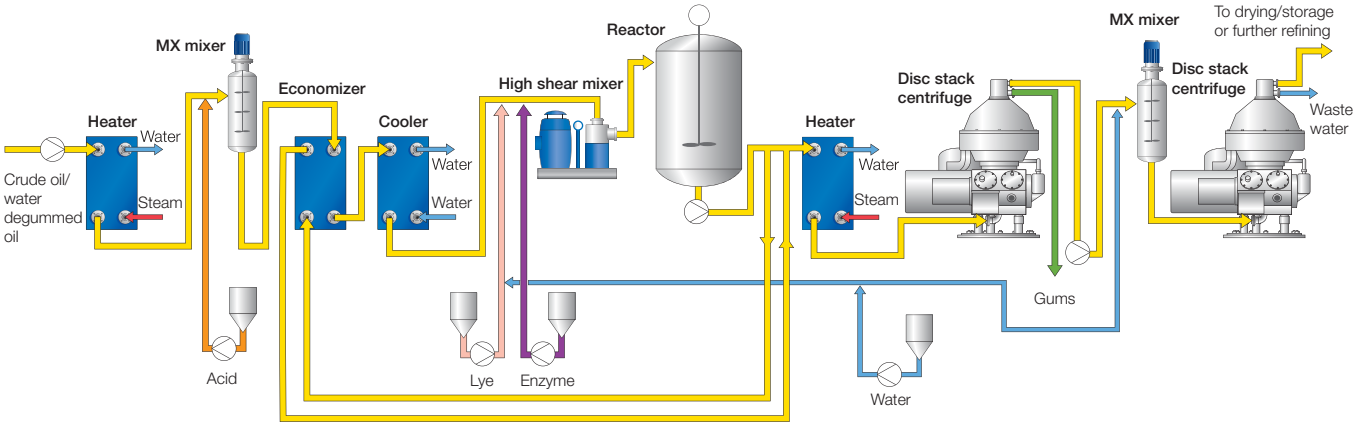


Conversion yields greater benefits

DSM's Purifine PLC enzyme (previously Verenium) is the first commercialized PLC enzyme available today. "Verenium is pleased to be working with Alfa Laval," said Janet Roemer, Executive Vice President, Verenium. "Implementing Purifine enzymatic degumming via Alfa Laval gives companies the security of dependable performance guarantees along with proven technology and know-how focused on edible oils and biofuels."

Molinos Río de la Plata, Argentina's leading soybean and sunflower seed processor, selected Alfa Laval to convert its San Lorenzo facility to the Purifine PLC degumming process. "Due to this innovative step, we've seen a significant increase in oil yields and processing margins, enabling our facility to exploit its potential even better," said Luis Palacios, Molinos' Industrial Manager.

Enzymatic deep degumming



Enzymatic deep degumming

Enzymatic deep degumming has also been developed for the physical refining of seed oils. To remove the gums to a level low enough to allow further processing, the crude oil has to be pre-treated with a small amount of acid. The pH is then adjusted with diluted lye before an appropriate enzyme is added.

For deep degumming of high-phosphorus crude oils, a PLC enzyme is used. PC and PE are converted into diacylyglycerols and water soluble phosphate esters, which are separated from the oil during centrifugation, along with un-reacted gums.

If a PLA enzyme is used, the enzyme converts both hydratable and non-hydratable gums into lyso-gums and free fatty acids. The lyso-gums are more hydrophilic, which makes them easier to remove from the oil during centrifugation.

Alfa Laval provides enzymatic deep degumming solutions that employ either PLC or PLA enzymes, depending on the oil treated.

Versatile process

Depending on the oil type and oil quality, enzymatic deep degumming is not always the most effective processing option.

That is why the Alfa Laval enzymatic deep degumming process provides the versatility that enables you to carry out:

- enzymatic deep degumming
- special degumming
- neutralization

using the same equipment.

The process is well suited for refining edible oil as well as pre-treating other oils as part of biodiesel production.

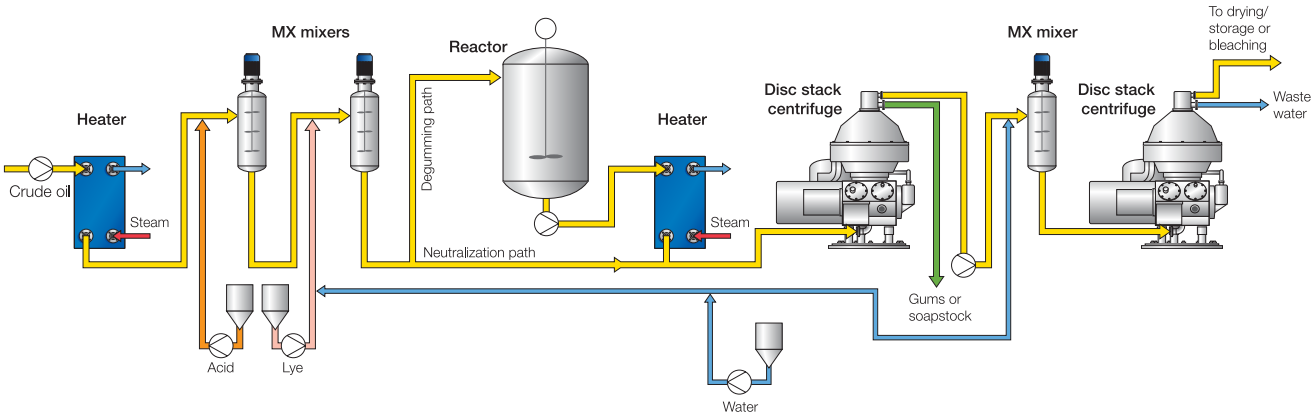
The Alfa Laval advantage

Using Alfa Laval equipment and technologies enables you to:

- produce degummed oil of better quality
- reduce losses of neutral oil
- increase oil yield
- cut down on operating costs.

Processes to suit all your needs

Combi Mix



Special degumming

Special degumming has been developed for the physical refining of seed oils. By adding a small amount of a suitable acid and diluted lye, at carefully controlled temperatures, you can separate both hydratable and non-hydratable gums from selected oils, right down to a level where these oils have a quality that is acceptable for further processing.

The gums that are removed at this stage are very sticky. This makes Alfa Laval self-cleaning disc stack centrifuges with a special Centrizoom paring disc outlet ideal for this separation task.

The Combi Mix process

In the case of low-quality seed oils, however, special degumming is not always possible. To maintain the quality of the final product, you have to give these oils the full caustic neutralization treatment.

If you want to carry out special degumming on as much oil as possible, but also know that you may well have to use caustic refining at a later stage anyway, the Alfa Laval Combi Mix process system is the ideal solution.

This two-stage process provides the flexibility you need to process good-quality seed oils that require physical refining as well as any lower-quality oils for which neutralization using caustic soda is the only viable way to remove impurities.

Everything you need

Alfa Laval can provide all the processing equipment you need to remove hydratable gums with water degumming, side by side with removing both non-hydratable and hydratable gums from seed oils using special degumming.

The Alfa Laval Combi Mix process system also provides opportunities for flexible switching back and forth between special degumming and neutralization operations, depending on the type and quality of the oil.

The Alfa Laval advantage

Using Alfa Laval equipment and technologies enables you to:

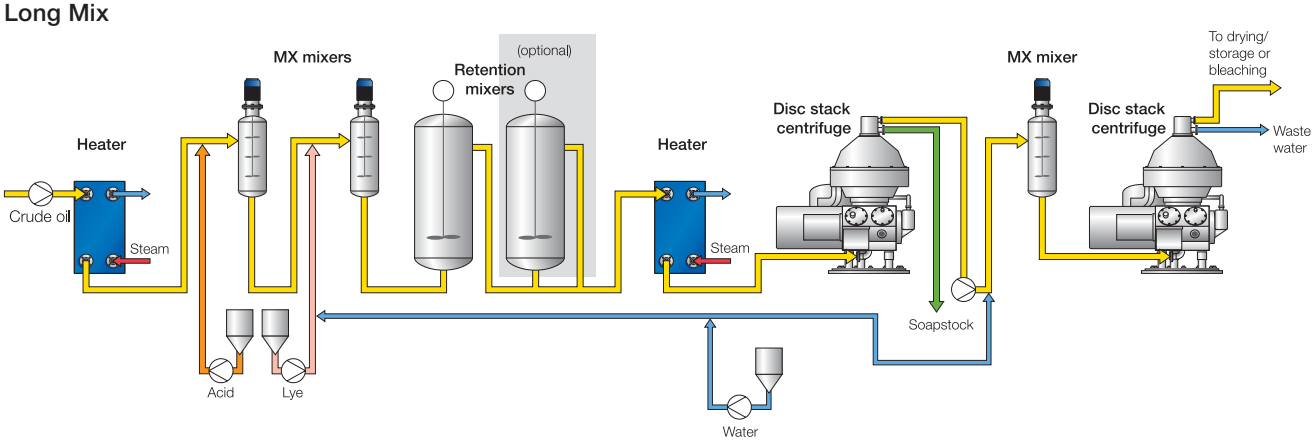
- ensure efficient mixing and separation
- implement plant control systems that increase efficiency
- pare down operating costs.

Not just a supplier
Odessa Maslozhircombinat (fats and oils plant in Odessa) is one of the leading producers of margarine, mayonnaise and bottled sunflower oil in Ukraine, with operations that include a sunflower oil refinery.

When the company ran into quality problems with its existing degumming process, it turned to Alfa Laval for assistance. The outcome was the installation of an Alfa Laval special degumming process line that helped the plant produce oil of a better quality, while also enabling it to reduce losses.

“Alfa Laval is not only a supplier to us but also a partner, guide and friend,” says Valeriy Fedorenkov, technical director.

Long Mix



Neutralization using caustic soda
The impurities you most often have to deal with in conjunction with fats and oils are the free fatty acids. These normally stem from lower-quality raw materials and/or inappropriate storage. The greater the free fatty acid content, the more challenging the purification process and the stronger the caustic soda concentration needed to neutralize and remove it.

Neutralization using caustic soda is widely recognized as an effective way to purify crude oils, and has the advantage that the soapstock formed by this process also encapsulates many other impurities. These include sugars, pigments and trace metals.

Neutralization of fats and oils using caustic soda refining is normally carried out continuously using disc stack centrifuges.

Once neutralization is complete, the oil is washed. The wash water is then removed using disc stack centrifuges, and the oil is dried in a vacuum dryer.

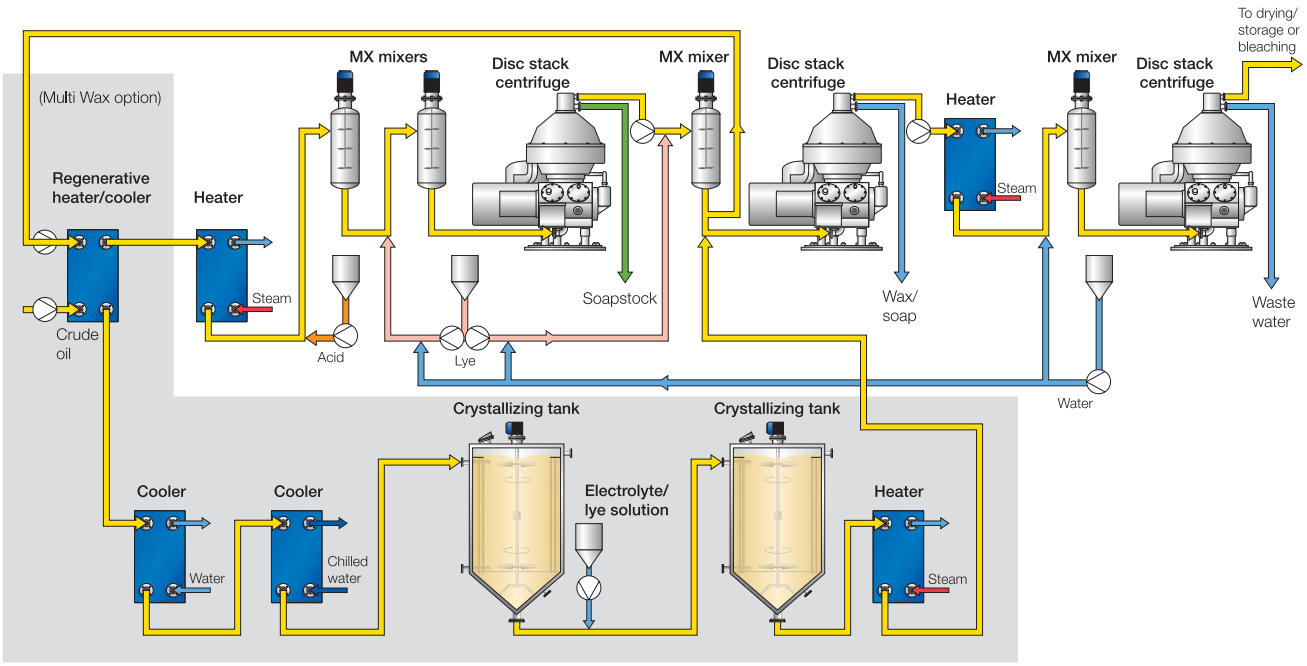
Two different approaches
Alfa Laval gives you the option of two different basic ways of neutralizing fats and oils.

The so-called Long Mix process is best suited for refining crude soybean or rapeseed oil. It features extended contact time in special retention mixers. Disc stack centrifuges are used to separate the soapstock and wash water from the refined oil, in one single washing stage.

The other main refining method is known as the Multi Mix process. This features a short contact time, which enables you to refine virtually any oil, using either one or two washing stages. However, if you intend to process cottonseed oil or crude fats and oils of low quality, a second lye treatment – commonly known as re-refining – will be necessary.

Mixing the way you want

Multi Mix



Removing wax

Certain vegetable oils, such as sunflower seed oil and maize/corn oil, contain waxes. Such oils have to be dewaxed to make them commercially acceptable.

The only way to completely remove all traces of waxes is to use cold filtration. However, if you can remove the bulk of these waxes prior to such filtration, you will be able to reap notable benefits in terms of reduced product losses, fewer filter aids used and more rapid processing.

Combined neutralization and dewaxing/winterization

This can either be done during the initial degumming process, or carried out more completely in a subsequent combined neutralizing and dewaxing/winterization process – such as the Alfa Laval Multi Wax process.

This uses the high-efficiency refining techniques of the Multi Mix process, combined with wax crystal separation and removal techniques that Alfa Laval originally developed for fractionating palm oil. This combination results in a well-refined oil with hardly any wax content.

The Multi Wax option provides you with an efficient way to remove waxes from oils with a high wax content, by extending the average interval between winterizing filter changes.

If your cold test requirements are relatively modest, it may then not even be necessary to undertake cold filtration at all.

Cold refining

An alternative to the Multi Wax process is cold refining, which combines dewaxing/winterization and neutralization. In this process, neutralization is carried out at low temperature, which ensures that the waxes are removed along with the soapstock.

The Alfa Laval advantage

Using Alfa Laval equipment and technologies enables you to:

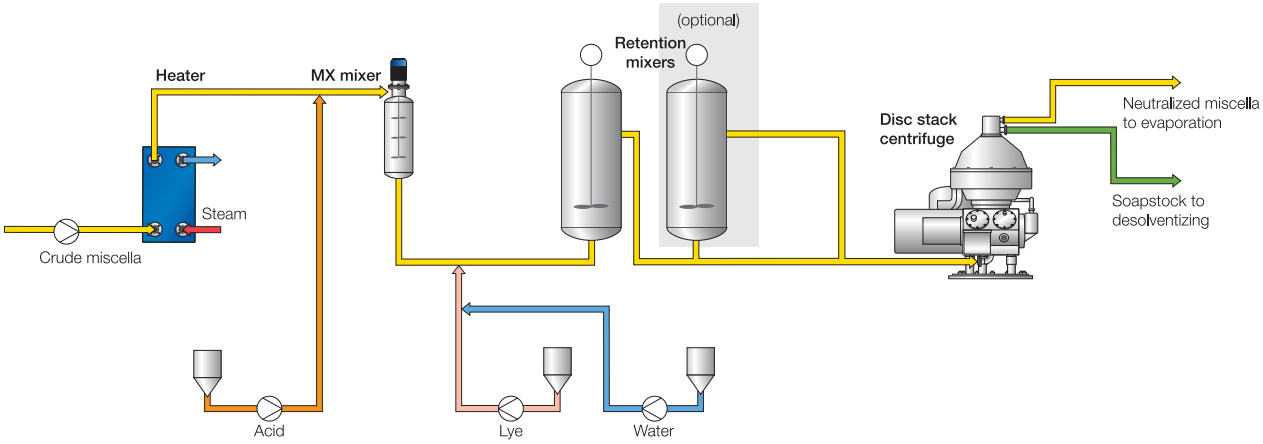
- implement plant control systems that increase efficiency
- benefit from unique Alfa Laval Centrizoom paring disc technology
- extend the average interval between winterizing filter changes
- reduce production costs.

Market leader in Morocco

Aïcha is the leading producer of marmalade, olive oils and tomato paste in Morocco. The company operates a refinery that uses 100% Alfa Laval equipment, including a SoftColumn deodorizing plant, disc stack centrifuges and heat transfer equipment.

"It's not an exaggeration to say this is the most sophisticated edible oil refinery in the country," says David Devico, managing director. "We are at least 10 years ahead of our Moroccan competitors."

Miscella refining



Removing gossypol

Crude cottonseed oil contains gossypol, which – amongst other things – gives the oil a dark colour and therefore has to be removed in order to make the oil commercially acceptable.

A particularly effective way of doing this is to neutralize the oil while it is in the midst of the extraction process. The oil and solvent mixture after the first evaporation, commonly called miscella, is reacted with caustic soda in specially designed retention mixers. The resulting soapstock is then removed in a special design of disc stack centrifuge.

Differences in density

The large difference between the densities of the neutralized miscella and the soapstock results in a very efficient separation in the disc stack centrifuge, which means it is not usually necessary to wash the oil afterwards. The soapstock is normally added to the cottonseed meal in the desolventizer/toaster while the neutralized miscella goes to final evaporation, where the remaining solvent is removed.

Dealing with solvents

The presence of solvents in the oil means that the disc stack centrifuge must be purged using inert gases, and all electrical equipment must comply with the appropriate explosion-proof regulations.

The Alfa Laval advantage

Using Alfa Laval equipment and technologies enables you to:

- achieve exceptionally efficient mixing and separation
- reduce operating costs
- eliminate by-product wastes, because soapstock is added to the meal.

Towards sustainable processes

Dealing with soapstock

The neutralization process results in a by-product known as soapstock, consisting of the sodium soaps of the free fatty acids present within the oil. Soapstock always requires subsequent treatment.

The traditional method of treating soapstock is known as splitting. The soapstock is split into fatty acids and water by acidification with strong acids – usually sulphuric acid. This is often considered an attractive solution because it is relatively simple.

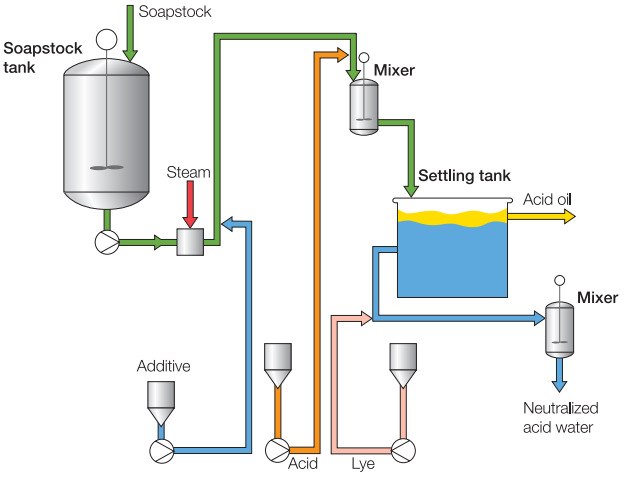
However, such a soapstock splitting process takes a relatively long time, and the equipment takes up a relatively large space. Furthermore, large amounts of sulphuric acid are required, and disposal is a challenge within current regulatory frameworks.

Less space, less time

To provide customers with a better alternative, Alfa Laval has developed a continuous processing system that is much faster and takes up substantially less space. It also reduces sulphuric acid consumption by as much as 50% and cuts down on effluent – with resultant environmental advantages.

If you process crude oils that have a high gum content, Alfa Laval can also provide you with a special processing solution for the soapstocks that result from this.

Soapstock splitting



The Alfa Laval advantage

Using Alfa Laval equipment and technologies enables you to:

- achieve fully continuous processing that gives you efficient mixing
- produce acid oil of better quality
- reduce the effluent load from your factory.

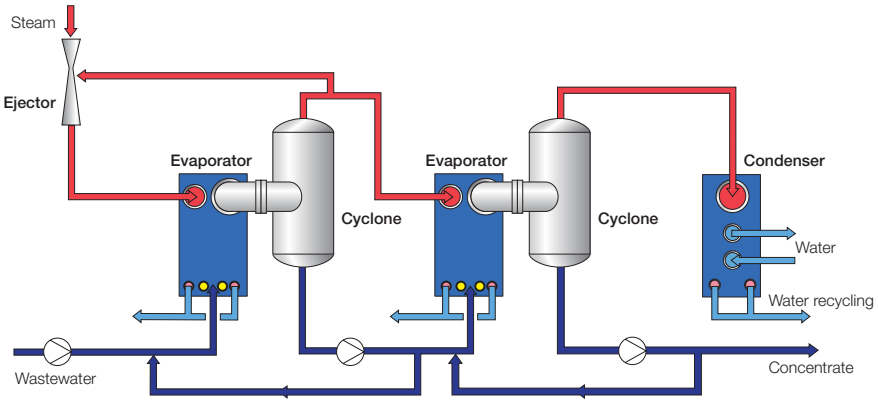
Wastewater evaporation

Within the typical edible oil processing refinery, water comes into direct contact with the oil in the course of numerous different processes.

Wash water, for example, normally results in an effluent with a water content higher than 97%, with only a small amount of organics such as neutral oil, free fatty acids, soaps and phosphatides. This provides conditions that are nearly ideal for recovery of the water component via evaporation.

Using steam to evaporate the water makes it possible to concentrate the waste product by at least a factor of 10, while at the same time recovering the condensate – which can be recycled as process water.

Two-stage wastewater evaporation



Recovering water helps eliminate several routine operating costs, including those associated with additional fresh water supplies, heating water to the desired temperature, and treating the effluent.

Effective heat transfer

Alfa Laval solutions for wastewater evaporation are based on the use of compact, thermally efficient plate heat exchangers.

Plate-type Alfa Laval evaporators and condensers are specially designed to handle large vapour volume flows under vacuum conditions. These make it possible to substantially reduce the physical size of the entire plant, on account of the exceptional heat transfer efficiency provided by this core Alfa Laval technology.

The Alfa Laval advantage

Using Alfa Laval equipment and technologies enables you to:

- recycle water once used
- reduce the effluent load
- save space.

Support that makes big differences to your bottom line

Supplying service
Alfa Laval is committed to providing you with the best possible service and help throughout the lifetime of any product or system we supply. We aim to help ensure that your process always achieves peak performance, with maximum reliability and a minimum of downtime. This makes a big difference to your bottom line.

The Alfa Laval Nonstop Performance concept is based on our worldwide network of service and spare parts distribution centres in more than fifty countries.

Prompt response
These regional centres mean we can deliver standard parts anywhere in the world within 24–48 hours, with the added advantage of lower freight costs. Alfa Laval expertise makes sure any service work is carried out with the absolute minimum of disturbance to your operations.

Full control over the entire supply chain associated with the company's equipment means we can provide you with prompt responses, excellent availability and lead times that are second to none.

The choice is yours
Alfa Laval service is based on knowledge and expertise obtained from years of experience working with customers whose focus is on processing edible fats and oils.

This means we see each unit and component within the context of your specific process, and understand the role they play within your business.

That's why we will work closely with you to tailor a service package that matches your individual requirements for optimizing performance, streamlining costs and reducing downtime. Whether it is on an "as needed" basis, via a standardized Performance Agreement, or as a customized service package, the choice is yours.

Hands-on help
Alfa Laval service experts are on hand to work with you as needed, right from removing old or defect units to installing and running in new ones.

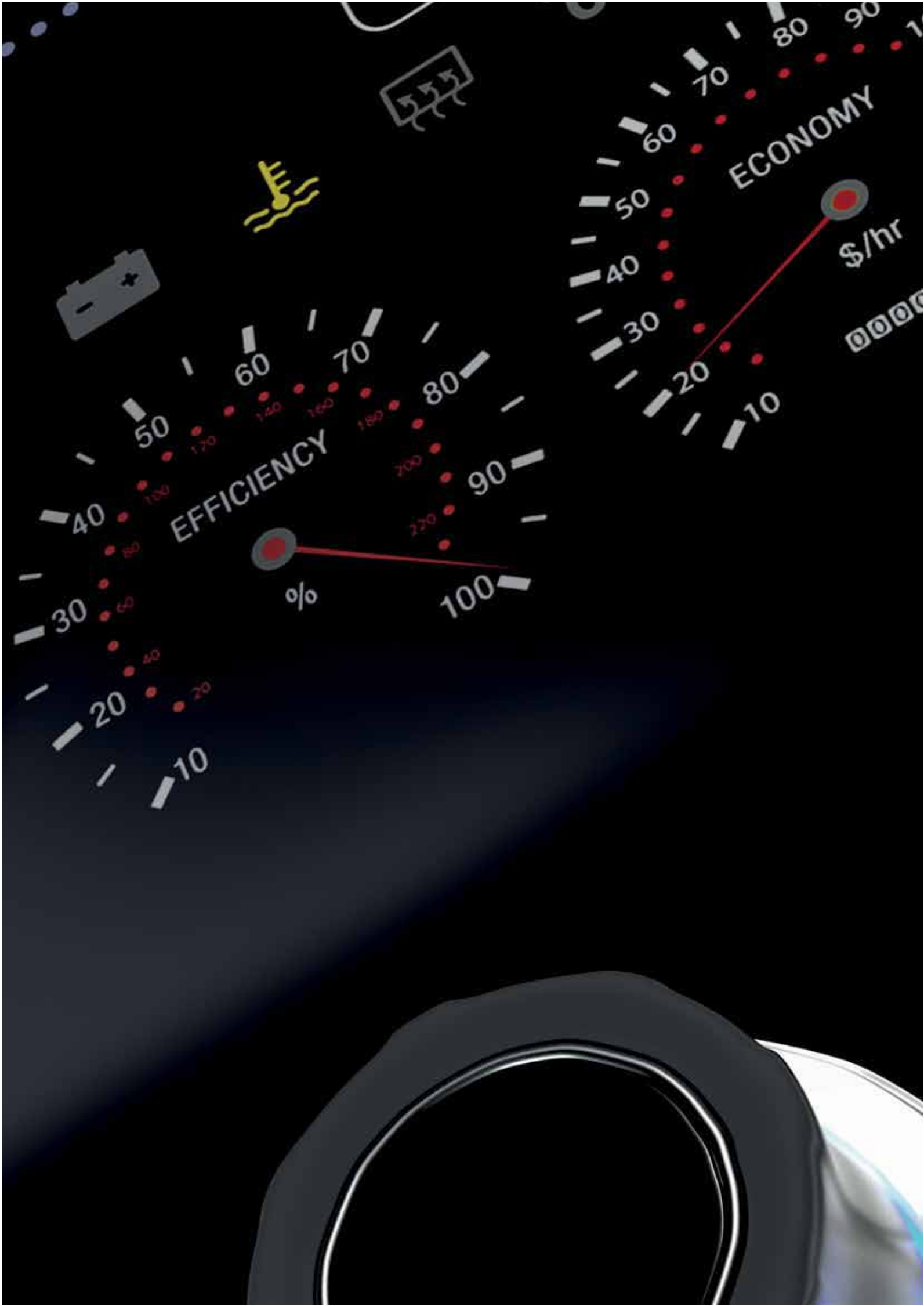
The service packages reduce unplanned downtime, extend equipment life and ensure rapid turnarounds. The aim is to relieve you of maintenance and service burdens, so you can focus on the details of your processes and your business.

At your disposal
Alfa Laval has the worldwide resources to help you throughout the service life of your fats and oils refining set-up. In addition to helping you tend to complete installations, we provide comprehensive service support for all individual items of equipment, including Alfa Laval heat exchangers, fluid handling equipment, decanter centrifuges and disc stack centrifuges.

Our customer service consultants are on call 24/7 to provide you with technical expertise, Alfa Laval genuine spare parts and service, operator training and field service – or just general information.

We can also provide exchange assemblies and upgrade your set-up as and when your requirements change and expand.

The know-how is there – and at your disposal right when you need it.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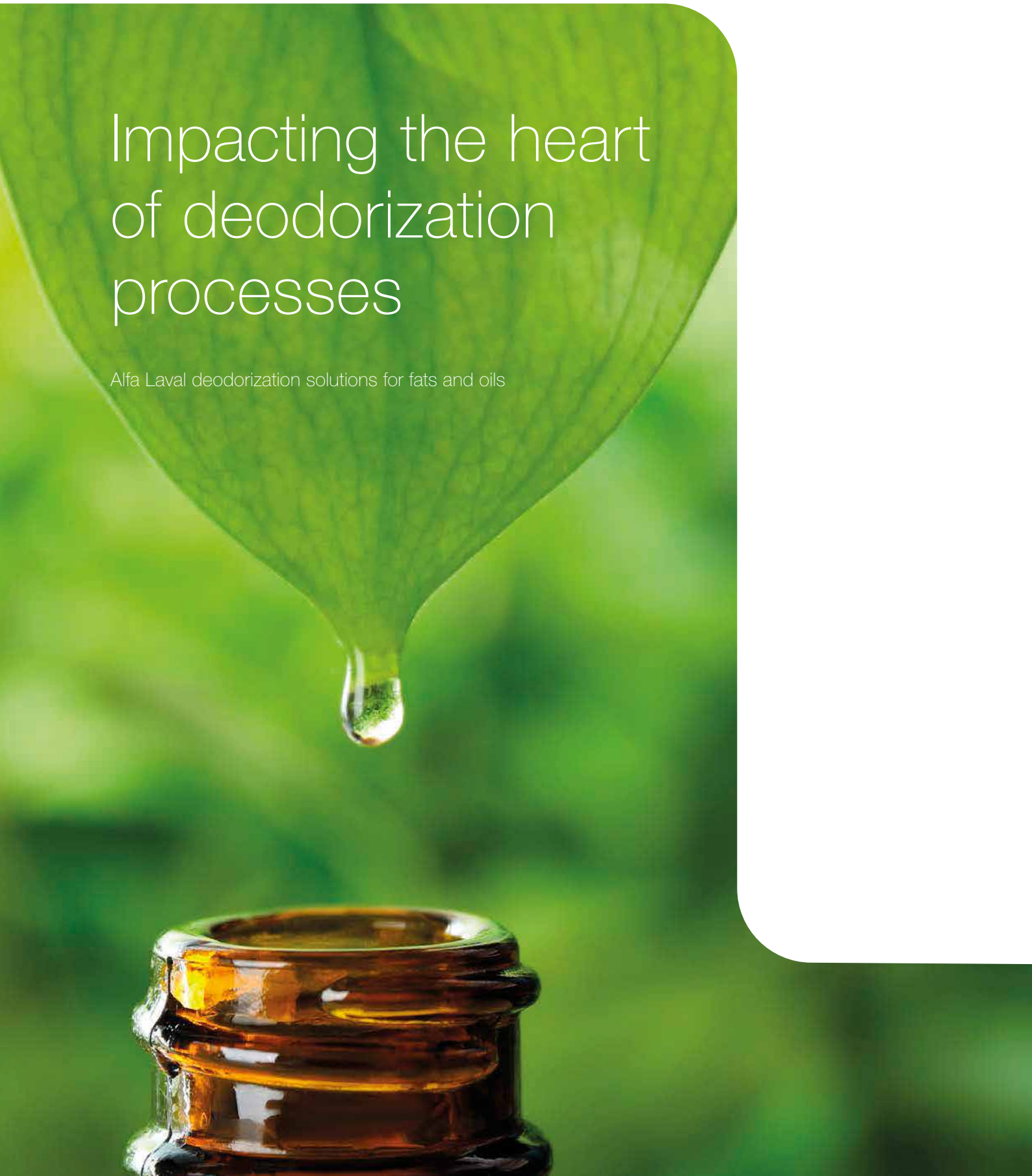
Impacting the heart of deodorization processes

Alfa Laval deodorization solutions for fats and oils



Deodorization is an absolute necessity in processing edible fats and oils. How efficiently it is done determines what you can achieve in your processing operations as a whole, in terms of removing odours, pigments and volatile substances.

In this specialist field, Alfa Laval deodorization solutions are uniquely effective – quite simply a cut above all else.

At Alfa Laval, we don't just make do with traditional deodorization thinking – we develop new and better ideas that later set the standard for the whole industry.

Optimizing edible oil deodorization

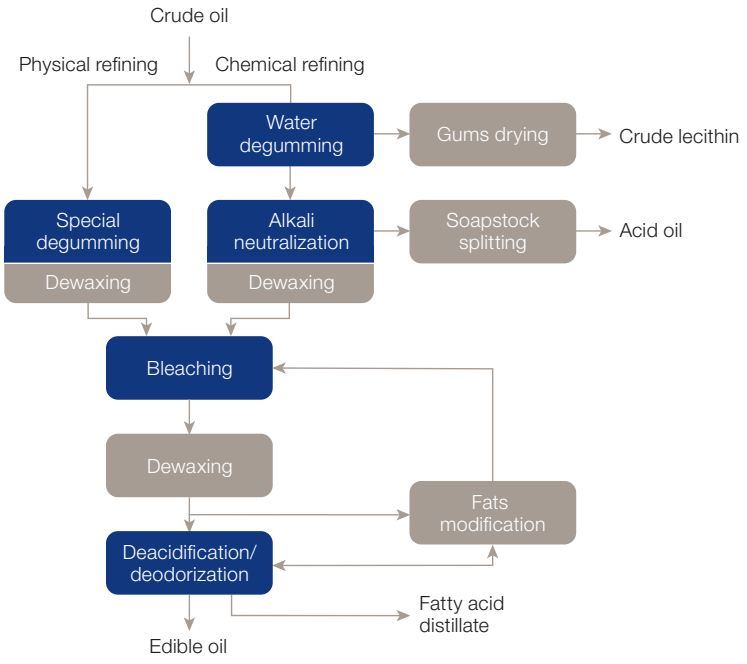
Patented thin-film technology sets new standards of efficiency

Deodorization is a crucial part of edible fats and oils processing that the only way to really get ahead – and stay there – is to use the latest technology and the best equipment.

Alfa Laval's patented breakthrough in applying thin-film technology to modern deodorization processes opens up important opportunities for taking your processing efficiency

to a new level. It enables you to use less steam and to process the oil at lower temperatures. This results in more gentle, effective treatment that greatly benefits the quality of your fats and oils.

The Alfa Laval SoftColumn™ deodorization concept is also designed to be extremely versatile. Separate stripping and retention sections provide a wide range of options for implementing the most efficient deodorization solution currently available – both in new installations and when extending and updating existing fats and oils processing installations.



The raw materials

The large majority of commercially produced edible fats and oils stem from:

- soybeans
- oil palm
- rapeseed/canola
- sunflower seeds
- maize/corn
- peanuts/groundnuts
- cottonseed
- coconut
- palm kernel
- fish and animal fats.

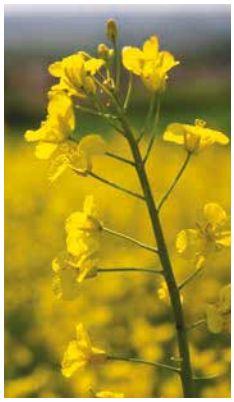
Multitude of uses

Alfa Laval SoftColumn deodorization solutions are particularly effective in:

- deodorizing seed oils
- deacidifying tropical oils
- producing oils with a particularly low content of trans-fatty acids (TFAs)
- removing problematic trace elements such as dioxins and pesticides
- processing fish oils and animal fats.

Essentials for top-quality fats and oils processing

Removing undesirable impurities with vacuum and steam



Removing undesirable elements

When processing edible vegetable oils and animal fats, it is crucially important to remove any undesirable compounds that can affect flavour, odour, stability and colour.

Deodorization is a vacuum steam distillation process in which steam is passed through such oils at very low pressure and relatively high temperature in order to remove any such substances still present after the preceding processing stages.

Beginning with deaeration

Before heating the oil, air must be removed under vacuum (deaeration) in order to protect the quality of the product by preventing oxidation.

After leaving the deaerator, the oil passes through a regenerative heat exchanger, the economizer, which heats the oil using the hot oil leaving the deodorization column. This ensures that as much heat as possible is recovered from the hot oil.

The oil then proceeds to a final heater where it is brought up to the exact temperature required for deodorization, normally using high-pressure steam.

Stripping and retention

When the oil has reached the designated temperature, it is fed to the deodorization column, which is the main component used for deodorizing edible fats and oils. Such a column can consist of a stripping section and a retention section.

When the oil passes through the stripping section, it is exposed to a combination of vacuum and steam that removes volatiles – including free fatty acids (FFAs) – that have a higher vapour pressure than the oil itself. If present, these volatile impurities affect the flavour, odour and stability of edible oils.

An Indonesian first

PT Grahadura Leidongprima is a family-owned business on the island of Sumatra in Indonesia. The company is very successful in the palm oil processing industry. To cement this position, the company ordered the first SoftColumn deodorization plant in Indonesia, accompanied by dry fractionation plants.

This Alfa Laval SoftColumn deodorization installation provides the company with a processing capacity of 1,000 tonnes of palm oil daily.

The oil is then held in a retention section for a certain amount of time for thermal treatment – known as heat bleaching – that deals with undesirable pigments and ensures the stability of the final product.

The length of time the oil is kept in the retention section depends heavily on the desired product specifications.

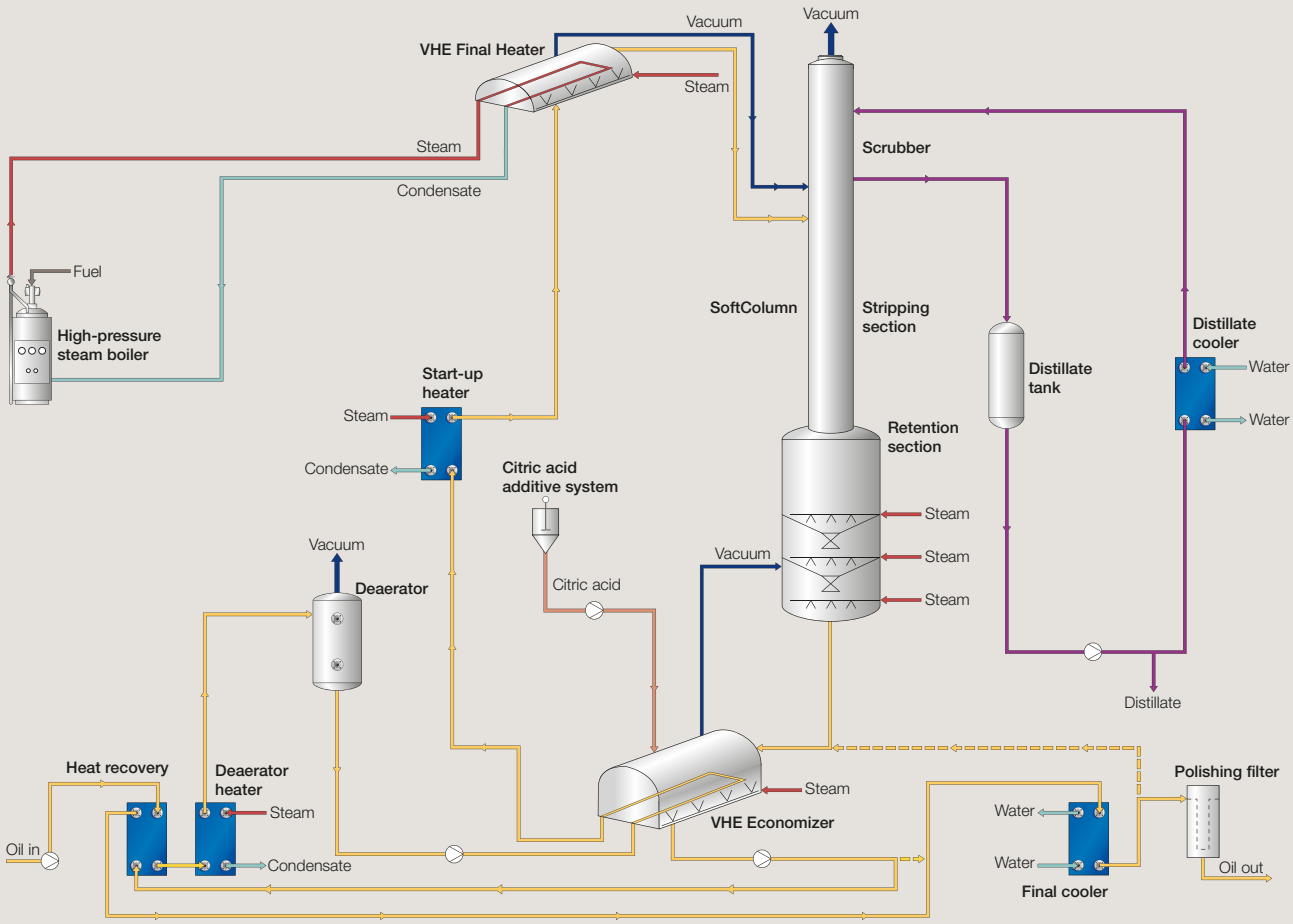
Condensing removed impurities

The volatile impurities that have been removed from the oil are condensed in a so-called scrubber unit, using recirculated and cooled distillate. The scrubber is either placed on top of the stripping section or built as a separate vessel.

Cooling

Finally the oil is cooled in two stages. First in the economizer, and then to the specified final temperature. It then undergoes polish filtration and is transferred to subsequent processes, storage or packaging.

Deodorization



A cut above the rest

Thin-film technology: lower temperatures and less steam

Traditional versus modern

In the traditional deodorization approach, the stripping of volatiles and heat bleaching are carried out simultaneously. However, this means that the oil is at higher temperatures for longer and that volatile substances are present throughout the treatment process.

In the modern Alfa Laval SoftColumn deodorization concept, on the other hand, the two parts of the deodorization process are kept separate. This ensures much better control of the process and fewer side reactions.

Patented technology, better results

The groundbreaking Alfa Laval SoftColumn design features patented technology that makes the oil flow in a thin film down specially structured packing inside the column.

Minimum of steam

The steam enters from the bottom and flows counter-currently upwards. Together with the packing, this ensures that the greatest possible oil surface area is exposed to both vacuum and steam under consistent, controlled conditions. This guarantees that the volatile impurities are removed rapidly and efficiently, using only a minimum of steam – thus cutting energy costs.

Less energy

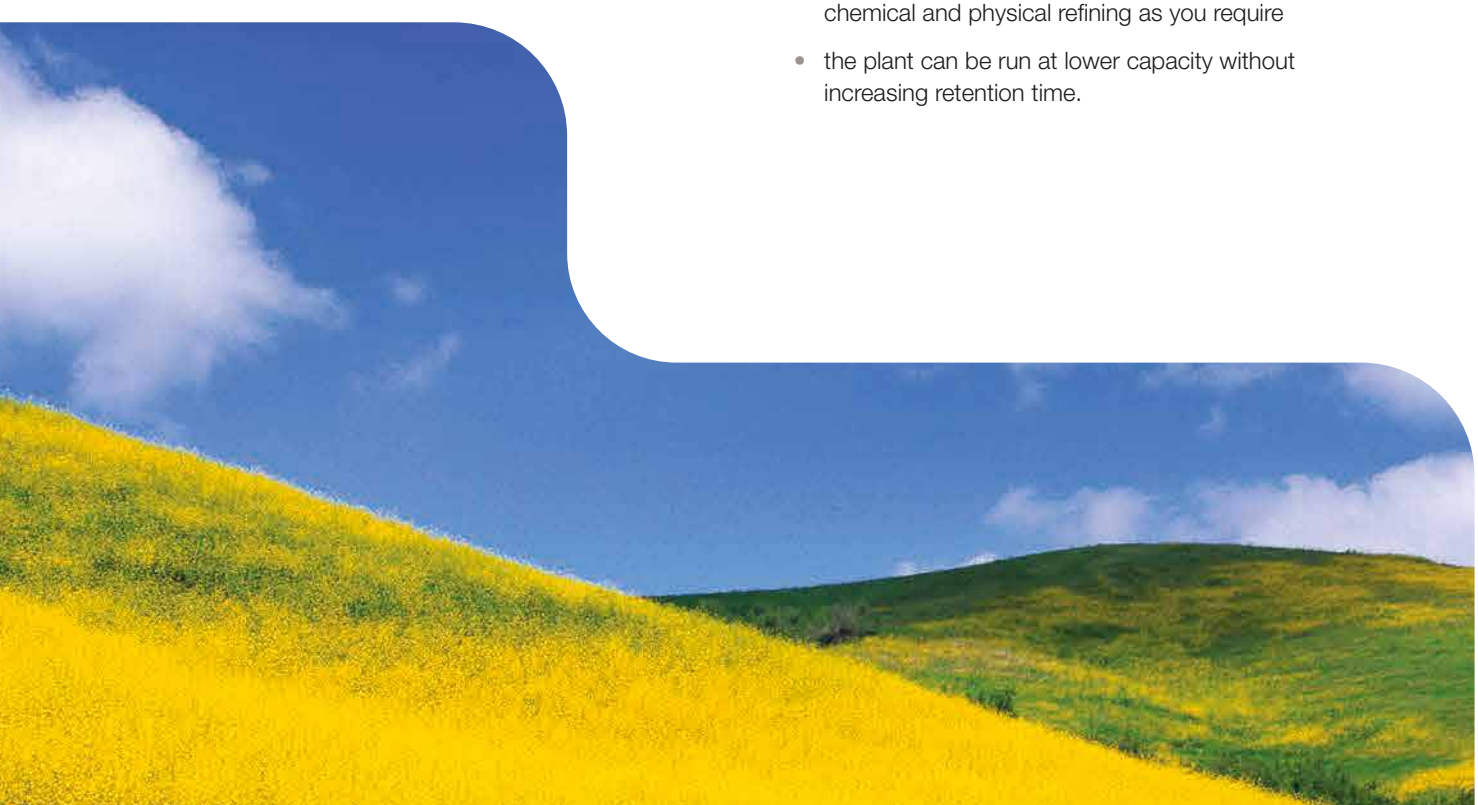
A special Alfa Laval heat recovery economizer heats the incoming oil, using heat from oil already deodorized. This ensures that less energy is required for heating the oil to the deodorization temperature.

Maximum flexibility

The SoftColumn design lets you adjust the colour of the oil as well as alter retention time and/or temperature at any point. Because the stripping and retention sections are separate, it is even possible to operate with different temperatures in each section, providing you with the best possible control of the deodorization process.

Other flexibility advantages include:

- the system can be designed to switch between chemical and physical refining as you require
- the plant can be run at lower capacity without increasing retention time.



Prevents side effects

Using the stripping-first/retention-later principle boosts deodorization performance significantly because the retention section operates with “clean” oil that has already been deacidified, thus helping prevent undesirable side effects.

The lower temperature and process time keep the formation of trans-fatty acids to a minimum without compromising other quality parameters.

Self-cleaning, no odours

The unique structure of the packing in a SoftColumn deodorization column means there is no risk of clogging or polymerization. The resultant flow pattern and the high turbulence this creates, along with optimized oil distribution and the completely airtight design, mean the installation is self-cleaning and free of odour.

The same structured packing technology is used in the scrubber unit to condense the volatiles removed from the oil.

Special SoftColumn features

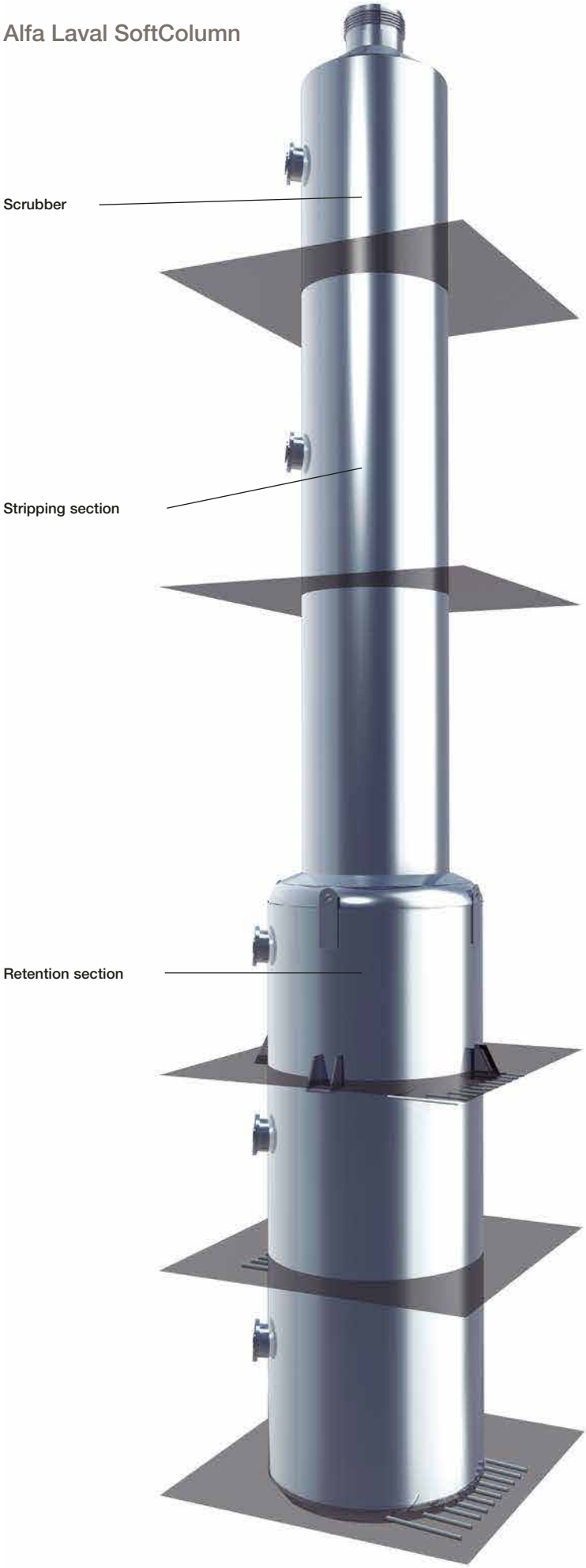
- ultra-efficient thin-film technology
- rapid stripping at lower temperatures and using less sparge steam
- achieve better control of anti-oxidant levels, tocophenols, trans-fatty acid formation and final colour via the flexible retention time
- stripping and heat bleaching kept separate
- modular system that is versatile, robust and easy to maintain.

Benefits add up

The Alfa Laval SoftColumn deodorization concept provides multiple benefits:

- lower steam and energy consumption reduces operating costs
- gentle treatment boosts product quality
- added flexibility in both installation and operation
- no air leakage, and undesirable side effects kept to a minimum
- self-cleaning design cuts maintenance costs.

Alfa Laval SoftColumn



More than the sum of the parts

Complete deodorization concept available in modules

A complete Alfa Laval SoftColumn deodorization solution consists of four modular sections. These can be installed separately to perform particular duties, but they are also ideal for combining into one highly efficient deodorizing system that will provide a significant boost to both your processing capacity and the quality of your finished fats and oils products.

Stripping section

Oil flows evenly down the structured packing in a thin film while steam flows counter-currently. This effectively exposes the oil to the vacuum and stripping steam.

Design features include:

- specially structured packing with an extensive surface area that reduces the amount of stripping steam needed and cuts down on retention time
- special packing with no stagnant zones to create a self-cleaning effect that ensures continuous operation.

Retention section

With a retention section that allows considerable flexibility in retention time and operating conditions, the deodorization process can be controlled and optimized to an even greater degree.

Design features include:

- special design that provides first-in/first-out flow
- flexible holding time
- rapid draining at stock changes and shutdown
- internal actuators that use steam as the pressure medium, preventing air leakage into the system.

Scrubber

The Alfa Laval Scrubber is a structured packing column designed to condense and recover FFAs and other volatiles from the deodorization process, and to prevent these being carried over to the vacuum system.

Design features include:

- structured packing with an extensive contact area that results in high efficiency and reduces the amount of recirculation flow distillate required
- self-cleaning as a result of the turbulent flow
- demister located prior to the vapour outlet to ensure that any small droplets are retained.

Largest in Latin America

The Bunge Group is a global agribusiness and food operation. The group's Food Products division is Latin America's largest oilseed processor and largest seller of bottled oils to the retail market. To extend this position, Bunge has invested in the largest vegetable oil refinery in Latin America. Located in Brazil, this major plant has a capacity of 1200 tonnes per day.

Alfa Laval is responsible for the complete refinery, featuring a neutralization section with two PX 110 separators, a bleaching installation and a complete SoftColumn deodorization solution.

VHE Final Heater

The patented Alfa Laval vacuum heat exchanger (VHE) Final Heater raises the temperature of the oil to that required for deodorization, under vacuum and sparging steam conditions. The highly turbulent flow on the shell side of this high-efficiency heat exchanger prevents the product overheating on the tube surface.

Design features include:

- counter-current flow pattern due to the special design of heating tubes and baffles on shell side
- special baffle system to ensure low velocity at vapour outlet
- sparge steam injected through perforated tubes on the bottom of the shell, below the heating tubes
- low liquid level to ensure the desired flow path
- sparge steam tubes that can be removed from outside for manual cleaning.

VHE Economizer

The Alfa Laval VHE Economizer provides gentle, highly efficient cooling of the deodorized oil, producing a better-tasting oil of higher quality.

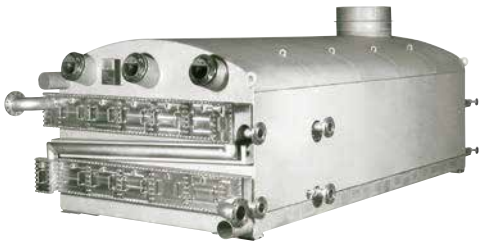
Due to the patented counter-current flow pattern and large heat exchange surface, VHE Economizer units achieve a particularly high heat transfer rate, with heat recovery levels of more than 80% for a single unit.

Volatiles that continue to form as the oil cools are promptly stripped, and are removed by the sparging steam and vacuum.

Design features include:

- sparge steam injected through perforated tubes on the bottom of the shell, below the heating tubes
- incoming oil heated in multipass U-tubes with high-turbulence flow
- a shallow channel system with baffles for optimized plug flow
- a connection for dosing antioxidant in the final channel
- first-in/first-out flow for controlled cooling under consistent conditions
- completely airtight conditions to prevent oxidation.

Alfa Laval VHE Final Heater



Alfa Laval VHE Economizer

Upgrading existing deodorizers

New paths for boosting production of fats and oils

Deodorizer upgrades made easy

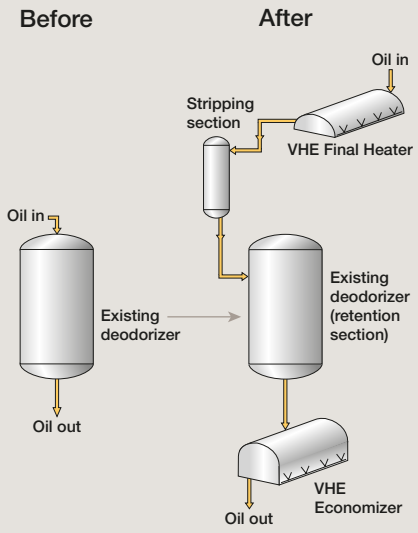
Simply re-use your existing deodorizer column and incorporate it into a new, improved Alfa Laval SoftColumn installation – no matter the make of your current equipment.

Upgrade your current deodorizer installation to:

- boost capacity
- improve product quality
- reduce production costs
- achieve greater flexibility.

The major Alfa Laval upgrade components are the stripping section, the scrubber, the VHE Final Heater and the VHE Economizer. These modular installations can all be connected to your existing deodorization column, with only a brief interruption of production.

Deodorization



Example of increased capacity:

100 MTD → 250 MTD
300 MTD → 500 MTD

Re-using existing capacity

Your existing vacuum system and the high-pressure boiler or thermal fluid heater can normally be re-used in an Alfa Laval SoftColumn solution that is on a larger scale. This is possible because it uses less steam and recovers more heat at any given capacity.

Retrofit in stages

You can also choose to upgrade your processing system gradually, with new equipment brought online in planned stages.

A new stripping section can be added to your existing tray deodorizer to increase capacity, boost efficiency and reduce operating costs. This will enable you both to boost the flexibility of your process set-up and to improve the quality of your end product.

A VHE Final Heater can be installed if the existing heater equipment is no longer able to heat the oil to comply with your operating requirements.

A VHE Economizer can be incorporated to improve product quality and save on energy costs.

A solution for carryover

If you are having to deal with problems that involve carryover, dirty cooling towers, environmental pollution or poor distillate recovery, Alfa Laval can also provide a separate scrubber.

This can be installed with any existing deodorization column and is based on the same structured packing technology as the Alfa Laval stripping section.

The upgrade advantage

Adapting the individual sections of the Alfa Laval SoftColumn deodorization concept to existing installations brings you advantages that include:

- increased capacity
- better product quality
- greater efficiency
- limited capital investment.

Nonstop Performance

Process know-how

One of the key advantages of working with Alfa Laval to install, update and extend your deodorization installation and equipment is our extensive practical experience.

Alfa Laval's proven ability to design and calculate a wide range of process configurations to meet specific customer requirements can provide you with the benefits of our vast body of accumulated know-how.

Engineering services

Alfa Laval provides a wide range of supplementary engineering services that can help ensure that your new installation comes on line as quickly and efficiently as possible.

We can also provide you with considerable savings by ensuring full compliance with relevant national and international regulations for design codes, safety procedures and best engineering practices.

Alfa Laval engineering services include:

- installation design in full accordance with international standards
- installation supervision
- commissioning and start-up
- operator training
- documentation
- comprehensive spare parts packages
- operational, maintenance and service support.

Full control

Alfa Laval has full control over the entire supply chain associated with the company's equipment. This means we can provide customers with prompt responses, and excellent availability and lead times.

Service counts

The Alfa Laval 360° Service Portfolio ensures greater uptime and availability, so you can maximize return on investment throughout the entire life cycle of your equipment. With a global presence with service centres and partners in nearly 100 countries, we offer you local expertise, supported by the global breadth and depth of Alfa Laval.

The retrofit payback

The Imcopa soybean oil refinery in Brazil decided on an upgrade path to tackle very high steam costs, plus problems with poor heat recovery in the company's existing plant.

Benefiting from the Alfa Laval retrofit concept, Imcopa upgraded an existing deodorizer and installed a new neutralization and bleaching line, plate heat exchangers, mixers and a PX 95 separator. This enabled the company to boost refinery capacity from 400 to 600 tonnes per day. This retrofit strategy, combined with Alfa Laval heat transfer technologies, enabled Imcopa to reduce overall production costs by more than USD 3 per tonne of oil – the investment paid for itself in less than two years.

Flexible bleaching solutions

Alfa Laval bleaching processes for fats and oils

Bleaching is one of the key processes in fats and oils refining, designed to remove not only pigments, but also a wide range of other impurities.

Most crude fats and oils contain impurities that have to be removed for both commercial and health reasons. Modern industrial bleaching technologies are the way to do this.

Flexible paths to bleaching results

Bleaching – simple yet complex

The bleaching of fats and oils is normally carried out either after alkaline refining or degumming, and prepares the oil for the final deodorization process. In the case of crude palm oil, bleaching is the initial stage of the entire refining process.

At first glance, bleaching seems a relatively simple process that consists of mixing the oil with a powder, blending for a few minutes and then removing the powder again.

However, this process is quite complex both in theory and in practice. And the term “bleaching” is in fact a somewhat misleading description for a complex refining process in which the removal of pigmentation is no longer the most important purpose.

Getting rid of impurities

The prime focus in modern bleaching processes is now the removal of a wide range of different impurities, of which pigmentation is only one. Such impurities can virtually be removed using new processes in which combinations of different bleaching agents are used to bind specific impurities. These are then removed when the bleaching agent is subsequently filtered out.

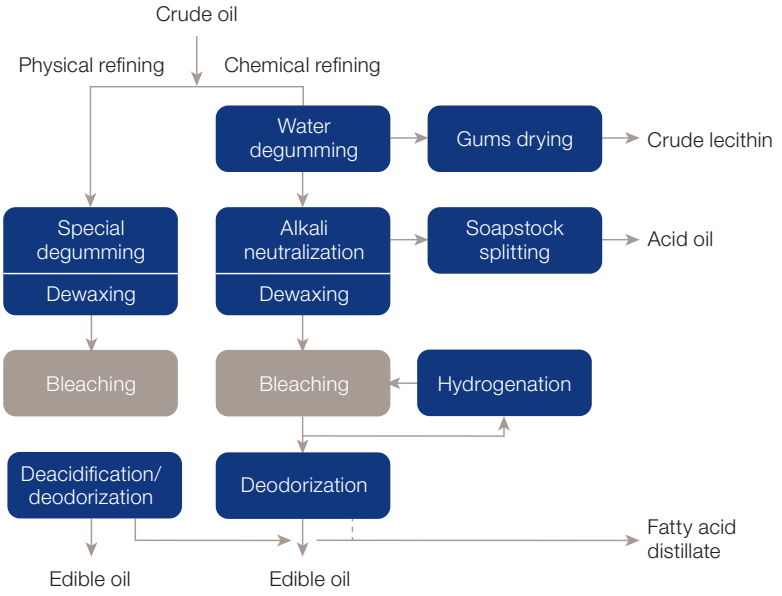
Efficient bleaching makes it possible to:

- remove certain pigments such as carotinoids and chlorophyll
- decompose and partially remove oxidation products
- remove contaminants such as soaps and trace metals
- remove traces of phosphatides
- remove polycyclic aromatic hydrocarbons and other pollutants.

All these substances can have adverse effects on both the quality and stability of your final product, and therefore have to be removed to ensure that the product is commercially attractive.

Bleaching agents

The most commonly used way to bleach fats and oils is to treat them with surfactant powdery materials. These bind (also known as “adsorb”) the pigmented substances in the oils to the extensive surface area provided by them being in powdered form.



The basis for modern bleaching

Modern bleaching processes use a substantial range of different bleaching agents in order to remove a wide range of specific impurities, in addition to the pigments.

The agents normally used include:

- natural bleaching earths (used with only limited colour-reducing effect but are particularly useful in treating animal fats)
- acid-activated bleaching earths (widely used for removing all kinds of impurities)
- activated carbon (used to remove polyaromatic hydrocarbons and to ensure the removal of a wide range of specific pollutants)
- synthetic amorphous silica compounds (used largely in wet bleaching, with a focus on selectively removing phosphatides, trace metals and soaps).

Wide range of uses

Bleaching also reduces the number of substances that can affect the taste and smell of the fats and oils. It is therefore used in refining and processing fats and oils that include soybean, palm, rapeseed, sunflower, palm kernel and coconut oils, as well as fish oil and lard.

However, the increasing quantities of environmental pollutants and other impurities often found in raw materials of all kinds mean that bleaching is rapidly becoming an obligatory part of treating all fats and oils.

This means that bleaching is crucial if you wish to ensure high-quality products, and is therefore normally included in all refining sequences.

The Alfa Laval advantage for bleaching process operators includes:

- flexibility
- exceptional reliability
- low energy costs
- easy operation.

Alfa Laval plate heat exchangers are ideal for heating and cooling the oil efficiently, both before and after the bleaching process.

Heat recovery using an economizer is also used in cases where the oil subsequently undergoes dewaxing.

Dry bleaching has several distinct advantages. These include:

- lower initial investment compared with other types of bleaching
- easy, straightforward control and operation
- only a minimum of space is required for installation
- lower operating costs due to the use of plate heat exchangers for heating and cooling which reduces utilities consumption compared with shell-and-tube solutions
- minimal energy consumption.

Mixing in the best

At the Prikolotnoye Oil Extraction plant in the Kharkov region of Ukraine, Alfa Laval supplied a complete dry bleaching plant with a multi-dosing system. Due to the flexibility of the design and Alfa Laval technical expertise, the company was also able to incorporate its own ideas about mixing and dosing into the system.

“Alfa Laval really listened to what we wanted, supplied us with highly efficient equipment, and made suggestions about how we could get the most out of it,” said Andrey Nepochatov, head of the refinery plant. “The system works perfectly.”

Dry bleaching

Dry bleaching is the method traditionally used for fats and oils. Although most common in Europe and Asia, it is a process that industry experts throughout the world are familiar with, and provides a viable solution in many processing situations.

Before it is mixed with bleaching earth, the oil is heated. If required, a citric acid solution is mixed with the hot oil to bind trace metals and decompose any residual soaps.

After this treatment, the oil is mixed with bleaching earth, activated carbon or a mixture of these two. This is done under vacuum to prevent oxidation, and in the presence of sparging steam.

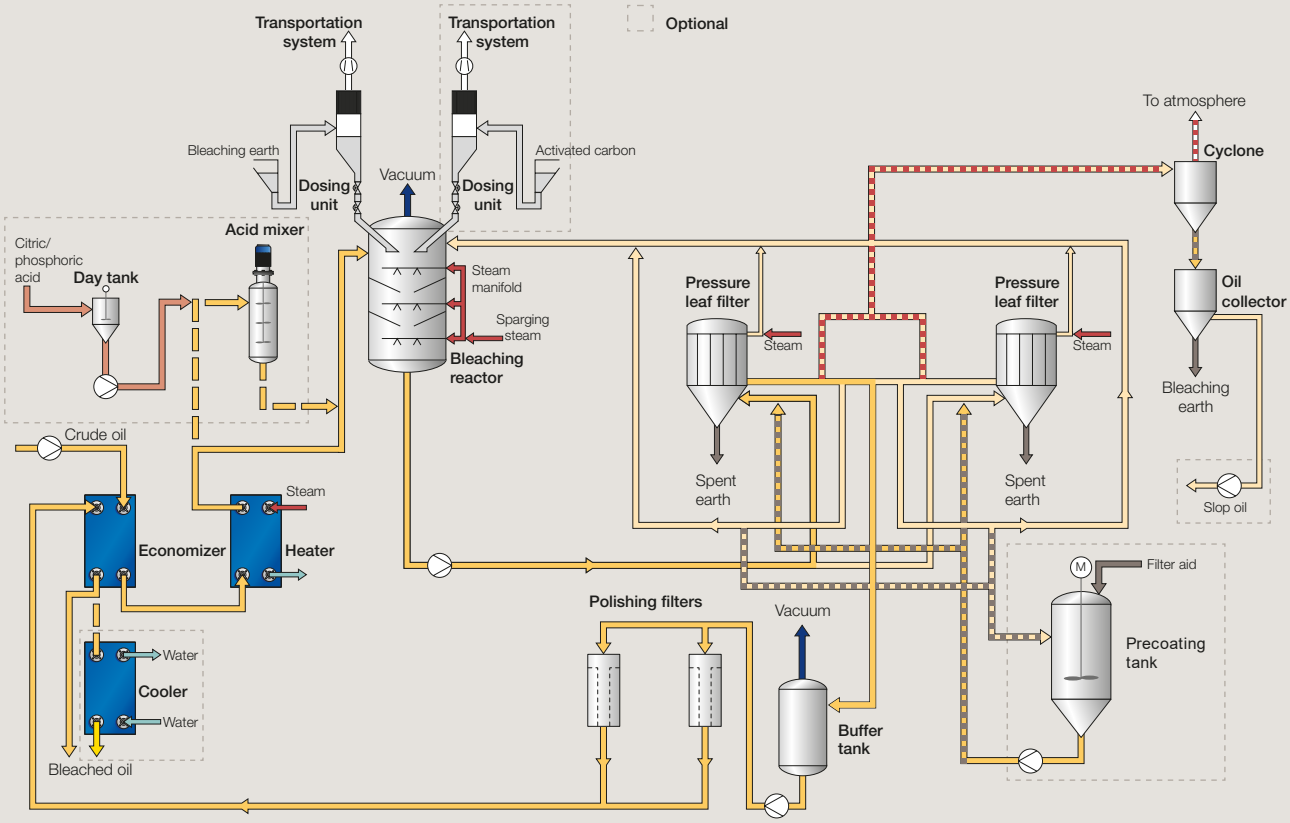
This process is called dry bleaching, because the bleaching reactor operates at a vacuum of about 70 torr, which greatly reduces the humidity in the oil.

After bleaching, the bleaching agent is normally removed using pressure leaf filters. Naturally, the filter cake that accumulates here still contains oil. Much of this can be recovered by steam-blowing the contents of these filters.

Filtered oil collects in the buffer tank, which operates under the same vacuum as the bleaching reactor. From there, oil goes via one of the polishing filters to the next process step, or to storage.

If it proves necessary to build up a filter cake in order to improve filtration, pre-coating can be accomplished by recirculating the oil through the filter via a precoating tank.

Dry bleaching



Just add water

Wet bleaching

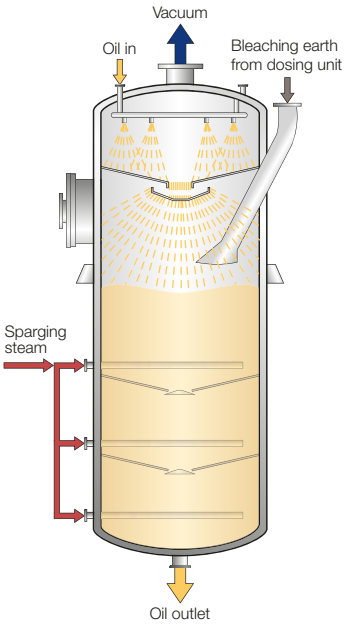
As the name implies, wet bleaching is a bleaching process in which water is added to the oil while it is in contact with the bleaching agent in the bleaching reactor.

The presence of small amounts of water results in more efficient use of the relatively expensive bleaching earth. This greater efficiency results in lower earth consumption as well as reductions of total oil losses.

This makes wet bleaching an attractive solution on account of the overall economics of the process, even though the investment costs are slightly higher.

The water present during wet bleaching is introduced in the form of a citric acid solution, or by taking wet oil from the separation line. Adjustment is carried out by careful control of the operating vacuum in the bleaching reactor to determine how much of the water subsequently evaporates.

Even tiny amounts of water – anything in excess of 0.5% – remaining in the mixture after this will cause filtration problems later on. The oil therefore has to be dried before filtration.



Alfa Laval bleaching reactor

In terms of the equipment used, the basic difference between wet and dry bleaching installations is therefore whether or not a dryer is located between the bleaching reactor and the filtration system.

The advantages of wet bleaching include:

- more efficient use of the bleaching earth
- easy to combine with a silica treatment process
- highly flexible
- low consumption of bleaching earth
- reduced oil loss during filtration.

Alfa Laval bleaching reactors

Under normal atmospheric conditions, mixing the adsorbent into the oil results in rapid oxidation, due to the large surface area of the active adsorbents. It is important to avoid this, which is why the design of Alfa Laval bleaching reactors ensures that the oil and bleaching earth are both deaerated before being mixed together.

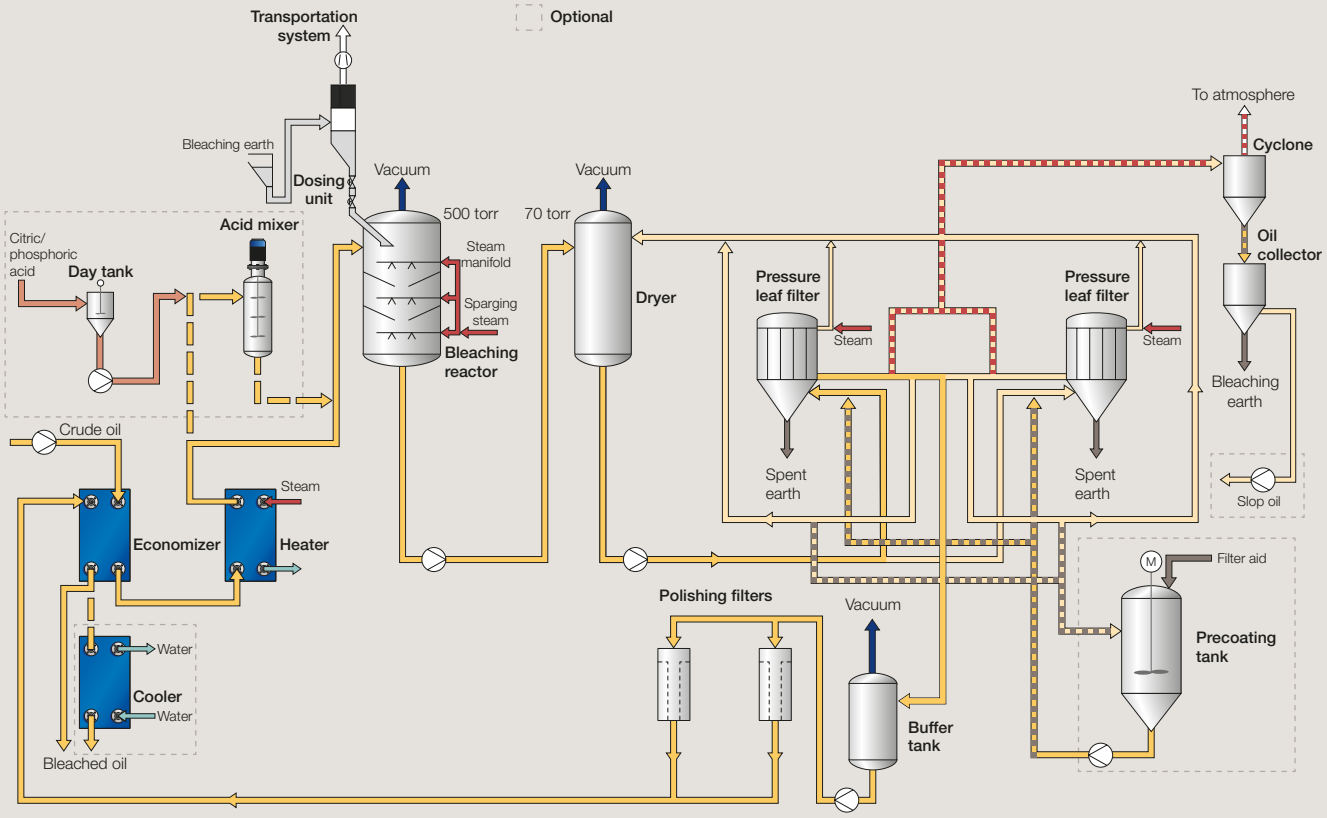
The spray curtain of oil entering the bleaching reactor from above, along with the special design of the reactor, prevents any of the bleaching agent being drawn up into the vacuum system above.

The reactor is divided into three compartments to ensure uniform reaction times and avoid oil flow short cuts inside the reactor.

It is not always possible to use steam to agitate the mixture. If not, the bleaching reactor can be equipped with a mechanical agitation system.

Alfa Laval bleaching reactor designs are equally suitable for both dry and wet bleaching, with no modification necessary.

Wet bleaching



Two into one does go

Two-stage bleaching

The two-stage bleaching process is essentially a combination of wet and dry bleaching, combined with highly efficient two-step filtration.

The main idea behind two-stage bleaching is to ensure that the dosing and filtration of the necessary adsorbents takes place between each stage of treating the oil. This means that the adsorption process can be made significantly more efficient.

This is because adsorption takes place on a continuous basis until there is equilibrium between the concentration of pigments and other impurities on the surface of the adsorbent and the concentration remaining in the oil. As soon as this equilibrium is reached, the adsorbent is filtered out of the oil.

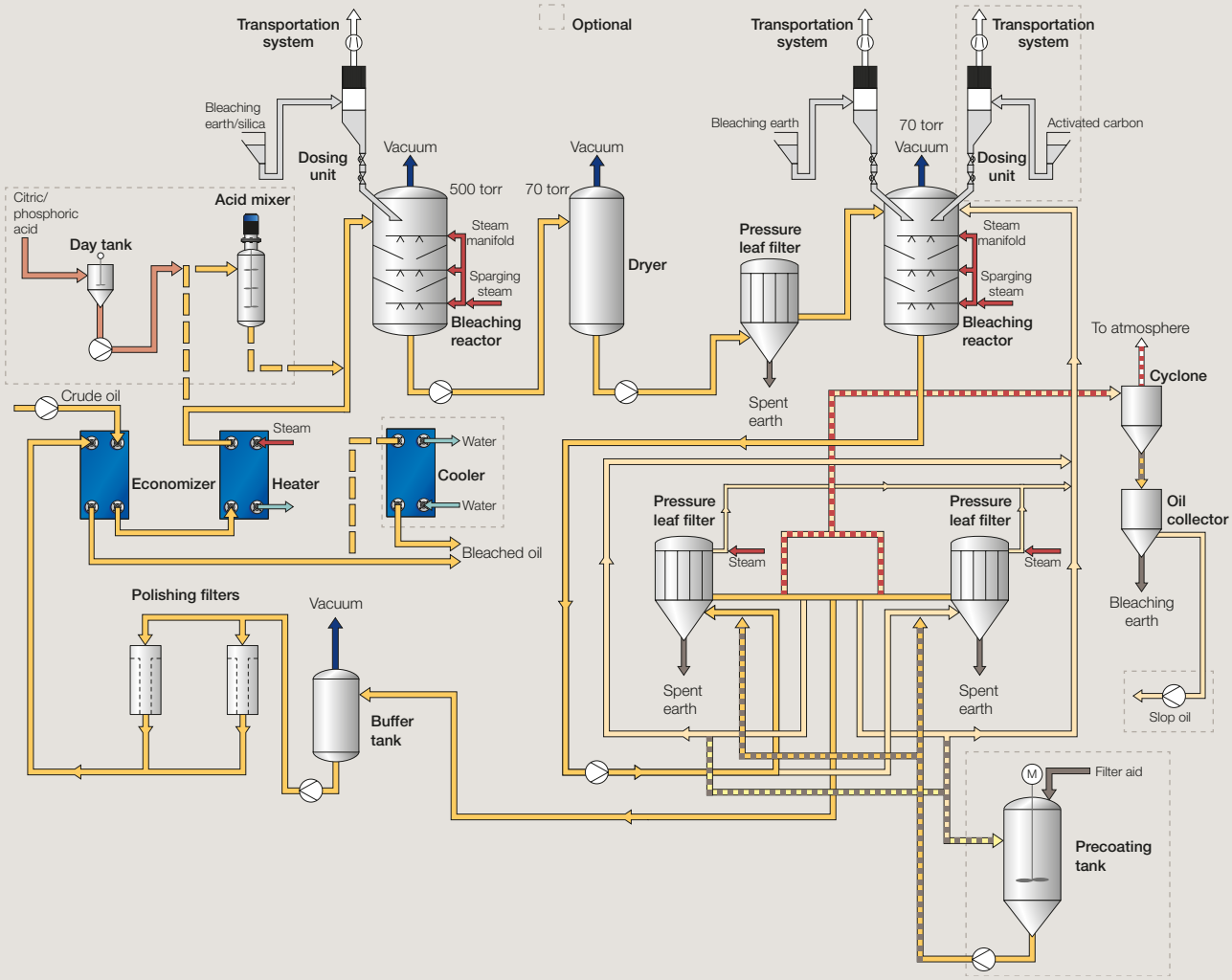
At the second stage fresh adsorbent is then added to the treated oil until a new state of equilibrium is reached. This oil then passes through a second filtration stage.

Two-stage filtration

The filtration section in Alfa Laval two-stage bleaching takes place in two stages, featuring three alternating filters working in cycle for maximum efficiency, with the almost saturated filter being used for prefiltration of the incoming oil.

This is because used bleaching earth from normal filtration processes still retains an estimated 20% of its adsorption capabilities. Alfa Laval two-stage filtration systems ensure more efficient exploitation of these relatively expensive filtration agents.

Two-stage bleaching



On the customer's wavelength

After carrying out a series of preliminary investigations and tests, under the supervision of Production Manager Niels Jørgen Eriksen, Fiskernes Fiskeindustri A.m.b.a. in Skagen (Denmark) awarded Alfa Laval the contract to deliver and install the process equipment needed to ensure that there are no traces of toxic pollutants in the company's fish oil products.

Niels Jørgen Eriksen said, "The Alfa Laval project has met our needs, and we are definitely satisfied with the results to date. The challenges involved in removing toxic pollutants have shown us the clear benefits of talking to experts who are really on our wavelength."

Using synthetic silica compounds

Two-stage bleaching is particularly relevant if you wish to use synthetic amorphous silica compounds as an adsorbent. These are particularly effective for removing phosphatides, trace metals, gums and soaps. Using synthetic silica also makes it possible to cut back considerably on wastewater from refining edible oils.

The best performance using synthetic silica compounds normally requires the presence of small amounts of water. This means that it is possible to extend a wet bleaching plant by adding a synthetic silica dosing system upstream.

The advantages of two-stage bleaching include:

- the best bleaching results for oils otherwise often considered difficult
- possibilities for using less expensive bleaching agents and first-stage adsorbents, thus reducing operating costs
- reduced bleaching agent loading, resulting in lower costs
- high degree of flexibility.

Multiple dosing

Alfa Laval experience has shown that in many fats and oils bleaching installations, the best results are achieved by using a combination of bleaching adsorbents. The percentages of the different additives used are altered depending on the type of oil, its quality and the adsorbents used. This makes it possible to use a substantial range of different adsorbents with different characteristics.

As an example, Alfa Laval bleaching reactors can be equipped with up to three dosing systems for maximum flexibility.

Dosing systems

The way the bleaching agent is added to the reactor is crucial for maximum efficiency. The dosing of the bleaching earth is set by changing how frequently the two valves above and below the dosing chamber open and close.

Alfa Laval dosing systems are designed to ensure a smooth, proportional flow, with an accuracy of ±0.03% in relation to the oil flow.

Alfa Laval provides the most straightforward dosing solution currently available. It provides greater dosing accuracy, lower operating costs, less maintenance and fewer spare parts.

Control systems

Alfa Laval supplies bleaching plants with a wide selection of different levels of automation to match customer requirements.

These range from relatively simple manually operated configurations with local control loops to fully automated plants based on SCADA control technologies.

Nonstop Performance

Service counts

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

Our expertise ensures that any service work required is carried out with the absolute minimum of disturbance to operations.

Process know-how

One of the key advantages of working with Alfa Laval to install, update and extend your bleaching systems and equipment is our extensive practical experience.

Alfa Laval's proven ability to design and calculate a wide range of process configurations to meet specific customer requirements can provide you with the benefits of our vast body of accumulated know-how.

Engineering services

Alfa Laval provides a wide range of supplementary engineering services that can help ensure that your new installation comes on line as quickly and efficiently as possible.

We can also provide you with considerable savings by ensuring full compliance with the relevant national and international regulations for design codes, safety procedures and best engineering practice.

Alfa Laval engineering services include:

- installation design in full accordance with international standards
- installation supervision
- commissioning and start-up
- operator training
- documentation
- comprehensive spare parts packages
- operational, maintenance and service support.

Full control

Alfa Laval has full control over the entire supply chain associated with the company's equipment. This means we can provide customers with prompt responses, excellent availability and lead times that are second to none.

Maximizing the value of modified fats

Alfa Laval processes for modifying edible oils and fats

Aiming at new horizons

If you're in the business of modifying oils into fats for the food industry, the key to success lies in providing your customers with high-quality products that meet their requirements perfectly – even at short notice.

Naturally, you also want to ensure that your processing operations remain safe while at the same time adding maximum value to your raw materials.

Alfa Laval provides you with the fats modification solutions you need to move up the value chain – safely and surely.

The benefits of fats modification

Fats modification processes open new doors so that you can offer more products, reach new customer groups and increase revenues.

There are also strategic advantages to be gained from modifying these fats. A move from the basic processing of bulk oils and fats enables you to focus on a wider market spread.

This in turn strengthens your company's ability to deal with the effects of seasonal demand, market fluctuations and the worldwide commoditization of basic agricultural products.

Opportunities abound

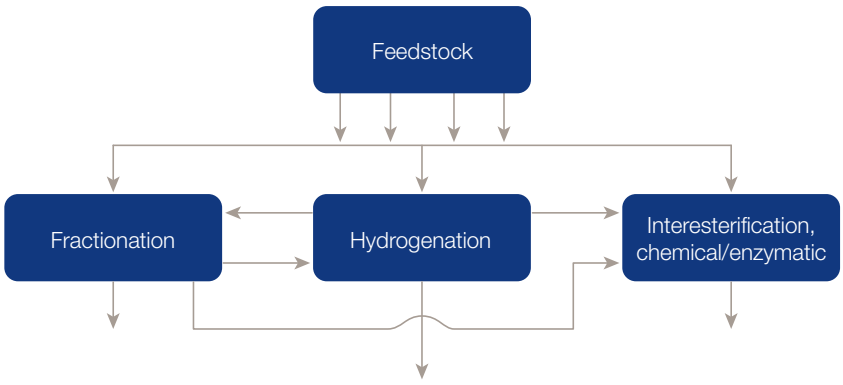
Installing Alfa Laval fats modification equipment provides you with a low-risk path into a world of new opportunities to:

- branch out into more products with higher value
- acquire new customers
- forge new types of customer
- relationships
- enter new markets
- move further up the value chain

The Alfa Laval approach provides flexible solutions that enable you to quickly, efficiently and safely vary production to meet changes in customer requirements and specifications.

Alternatives in fats modification

Depending on the products your customers are interested in and the raw materials you have available, you can choose between several different Alfa Laval solutions, or a combination of these.



Converting oils and fats naturally

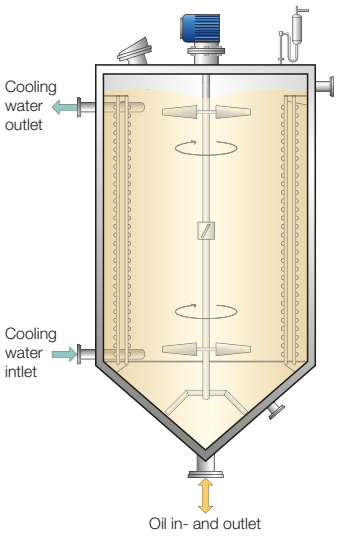
The natural way to modify oils and fats

If your feedstock stems from palm oil or animal fats, there is a direct, natural way to modify it to ensure that it acquires greater value. By separating the feedstock into liquid and solid fractions, or by combining different fractions, you can create products that match your customers' exact specifications.

Fractionation consists of gently cooling oils or fats in an accurately controlled process, making it possible to crystallize the hard fat content.

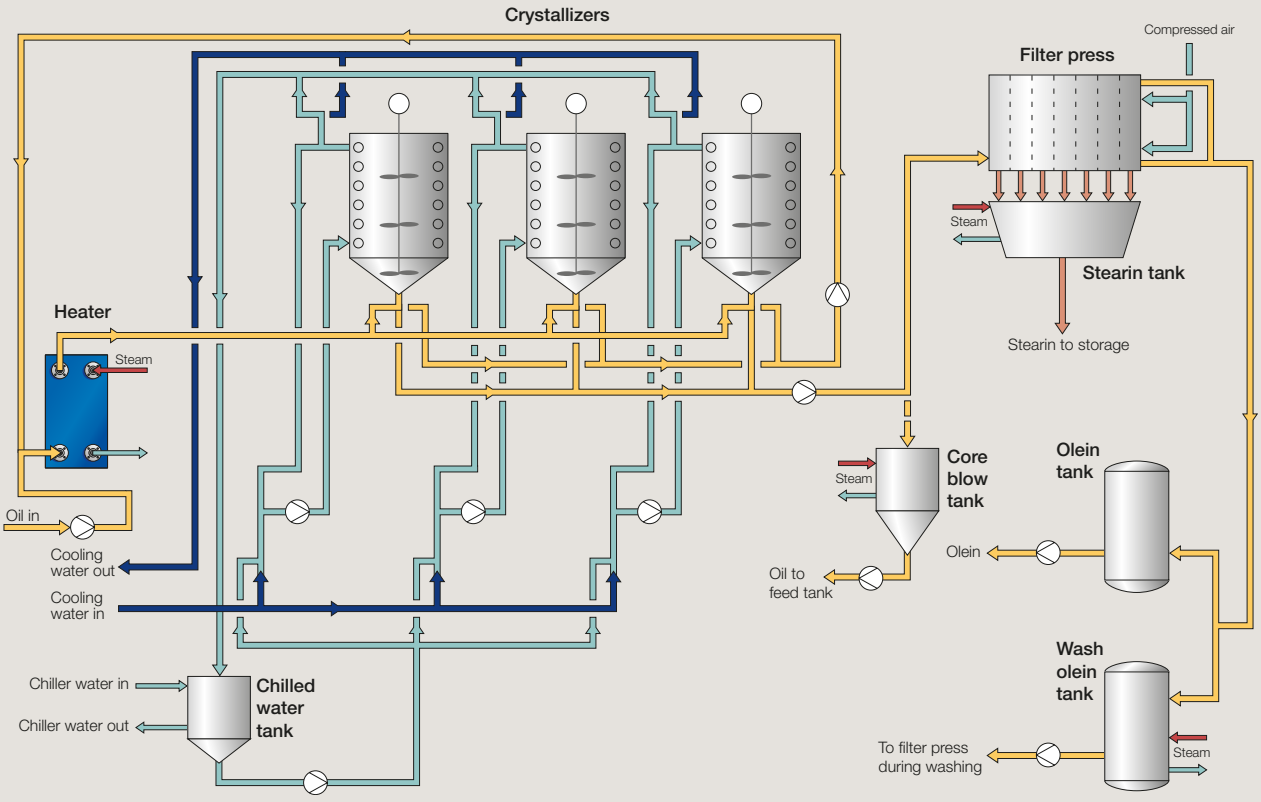
In dry fractionation, the fat is kept at a temperature at which it is in a partially liquid form. The crystals are then separated from the liquid fraction by membrane filtration. The result is two distinct products with different physical properties and melting points.

This can be achieved with absolutely no chemical modification, making this the "natural" way to produce hard fats.



Alfa Laval crystallizer

Fractionation



A schematic diagram of the dry fractionation process

Taking dry fractionation still further

The Alfa Laval dry fractionation plant at the palm oil refinery run by IOI Edible Oils features six crystallizers and one filter press. Here, dry fractionation is more than just a way of producing cooking oil. Advanced PLC systems have been added for efficient control and top-quality results.

“Alfa Laval has simplified dry fractionation into a process that is easy for the operator to interface, and thus transformed the technology,” states Kenny Liew, Deputy Plant Manager for IOI Edible Oils Sdn Bhd in Malaysia.

The Alfa Laval advantage

Alfa Laval crystallization and filtration equipment for fats modification processes features:

- upward flexibility – the modular design makes it possible to increase production capacity to keep pace with demand, by adding more crystallizers and extending filter capacity.
- excellence in process and engineering solutions – by designing and specifying the most suitable key components, such as crystallizers, membrane filters, pumps and instruments, the Alfa Laval system ensures high process efficiency.
- highly effective crystallizer design – using the best vessel engineering design, construction materials, surface finishing, design of the cooling coils and agitation that produce crystallized slurry ideally suited for membrane filtration.
- high yields – efficient crystallization and accurate process control result in good separation of the liquid and solid phases as well as ensuring greater yields and higher profitability.
- practical design – Alfa Laval equipment is designed to be straightforward, practical and easy for you to install, operate, clean and maintain.
- plant control – the system is available with different levels of automation, to suit your particular requirements.

The combination of automation and the closed loop cooling system makes it possible to achieve a virtually unlimited range of different cooling curves.

Versatile, modular hydrogenation

The versatile way to modify fats

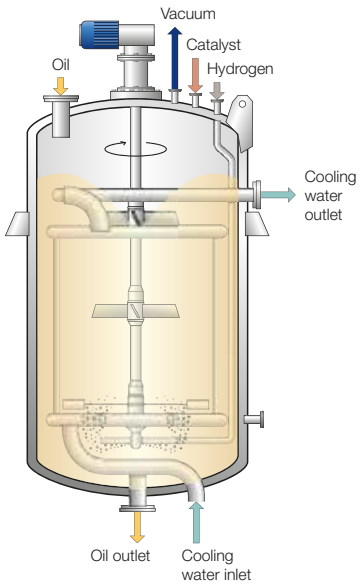
Oils and fats from virtually all kinds of raw materials and ingredients can be modified into hard fats by altering their molecular structure.

This is done by hydrogenation – the name given to the process in which hydrogen is chemically combined with unsaturated oils and fats, by making it link up with the double bonds of the unsaturated fatty acid chains.

Essentially, this process consists of bubbling hydrogen gas through the oils, normally at temperatures of 150–200°C (302–392°F), under pressure and in the presence of a catalyst. This adds the hydrogen atoms to the double bonds of unsaturated fatty acids, either to reduce them or to produce fully saturated fats.

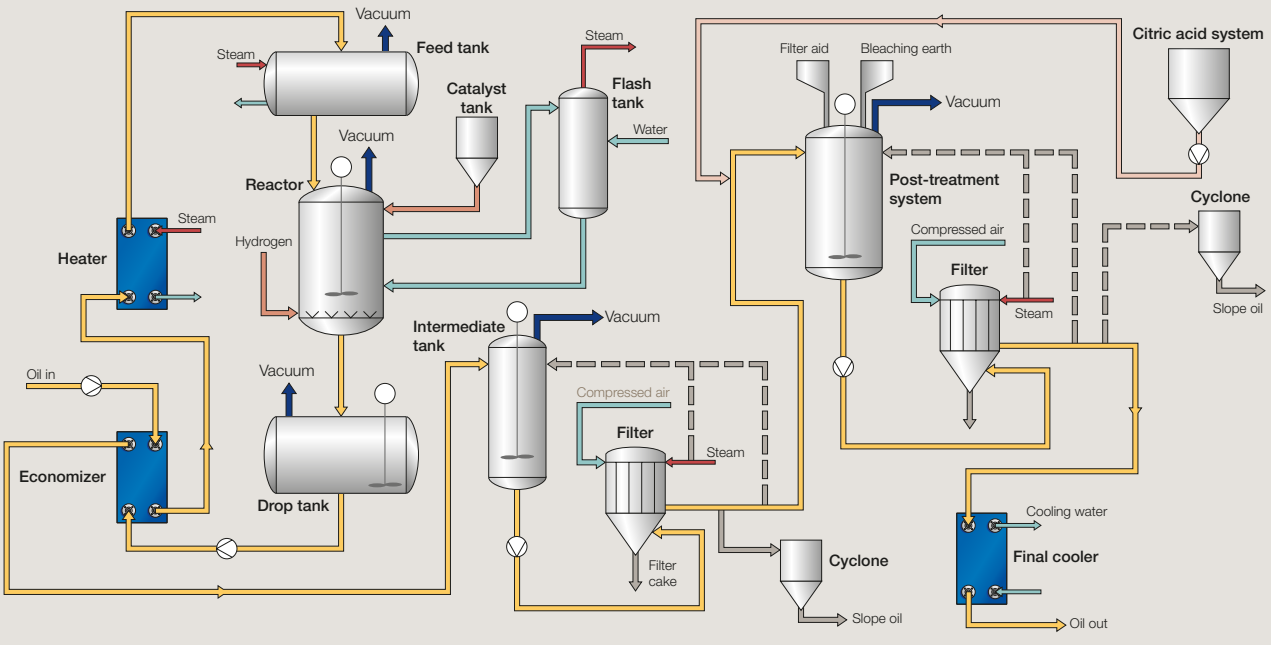
Hydrogenation raises the melting point of oils and fats and improves a range of other properties, including taste and shelf-life qualities.

The diagrams to the right and below show two systems based on filtration and continuous centrifugal separation that Alfa Laval provides for catalyst removal.



Alfa Laval reactor

Hydrogenatic



A schematic diagram of the hydrogenation process

Unlimited flexibility

The Alfa Laval hydrogenation plant supplied to CALSA features a feed tank, a drop tank and a dead-end reactor. Heat recovery is done by a highly efficient AlfaRex TM20 plate heat exchanger. Catalyst removal is undertaken in two steps, using direct filtration followed by a post-treatment system. The plant is fully automatic, controlled by a PLC unit.

"Alfa Laval supplied us with a highly efficient plant, with the lowest production costs in terms of energy, hydrogen and catalyst consumption. It gives us unlimited flexibility to produce any type of fats we want," states Mr. Alejandro Murillo, plant manager of CALSA – Cia Argentina de Levaduras S.A.I.C. – Argentina.

Low production costs

Alfa Laval hydrogenation equipment significantly reduces production costs by ensuring low production costs, full energy recovery, minimized hydrogen consumption, good catalyst distribution and contact with the oil, and a reduced temperature difference between oil and water.

- Low production costs. Highly efficient heat exchangers heat the incoming oil while simultaneously cooling the hydrogenated product, thereby maximizing heat recovery.
- Full exothermic energy recovery. Using a closed loop cooling system ensures maximum energy recovery from the exothermic reaction.
- Minimized hydrogen consumption. Special agitation techniques incorporate most hydrogen into the oil before it reaches the reactor head space. Vortices on the surface of the oil also force the hydrogen in the head space back into the oil. The result? Use of exactly the right hydrogen quantities.
- Good catalyst distribution and contact with the oil. Low speed and high flow agitation ensure good catalyst distribution and contact with the oil. The filtration rate is improved, as the catalyst is not converted to colloidal form.
- Reduced temperature difference between oil and water. The use of a closed loop cooling system and natural recirculation prevents the water hammer effect and improves temperature control.

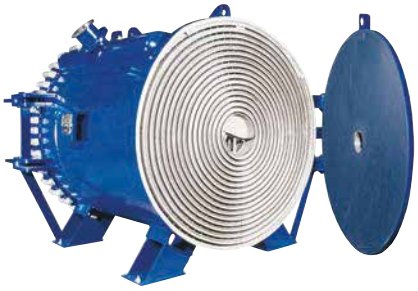
Greater flexibility

Alfa Laval hydrogenation equipment also lends a greater degree of versatility to your operations. A wide range of operating parameters makes it possible to produce saturated or partially hydrogenated fats with different specifications. These parameters include hydrogen flow rate and pressure, reaction temperature, degree of agitation and amount of catalyst.

Hydrogenation solutions using Alfa Laval equipment also make it possible to vary batch size and plant capacity, according to specific requirements. Feed and drop tanks contribute to increasing production and heat recovery. In addition, the reduced oil volume in the heat exchangers makes stock changes easier and reduces contamination.

High degree of safety

What's more, the explosion-proof design of Alfa Laval hydrogenation equipment keeps the hydrogen within the reactor, ensuring plant safety. Special seals with leakage detectors ensure early detection, should any leaks occur.



Alfa Laval spiral heat exchanger

AlfaRex® economizer

Transforming edible oils and fats through interesterification

Want to combine an efficient, flexible production set-up with the ability to satisfy ever-changing customer demands? Interesterification can help.

By combining different oils and fats, interesterification makes it possible to produce hard fats from a wide range of raw materials – and in a way that conforms to modern market demands.

Traditional interesterification is carried out by using a chemical catalyst (normally sodium methylate) to bring about a regrouping of the position of the fatty acids on the basic glycerol molecule.

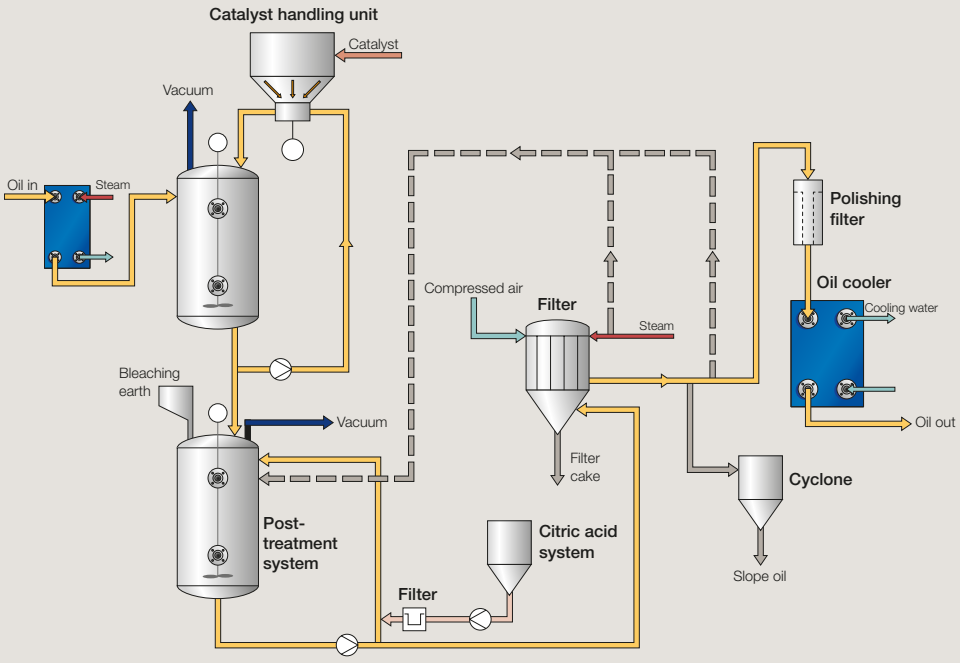
The mixture of oils and fats is pumped from the mixing tank to a steam heater and then to the reactor under vacuum conditions for drying. To improve drying efficiency, the oil is pumped through a recirculation section.

After drying the oil, a catalyst is introduced into the oil recirculation stream, using the special catalyst dosing device. When the catalyst reaction is completed, the oil is discharged to the post-treatment reactor. Here, the catalyst is deactivated with acid and the oil is treated using bleaching earth.

As an alternative, the catalyst can be deactivated with water in the washing tank. The soap generated in this process is removed using a disc stack centrifuge. The oil is then dried and sent to the post-treatment stage.

Interesterification does not affect the degree of saturation of the fat, nor the location of the cis-trans chemical bonds. It is largely done to control the consistency of the oil or fat at different temperatures, a parameter that is crucial for your customers in the food industry.

Interesterification



A schematic diagram of the interesterification process (catalyst deactivated with acid)

Advantages of interesterification

Alfa Laval interesterification equipment used in fats modification processes includes a specially designed catalyst handling system. The system includes:

- A hermetically sealed catalyst handling unit, which allows manipulation of the catalyst bags without direct contact between the product and the operator, thereby ensuring a safe, inert environment.
- A catalyst dosing unit ensures the use of accurate amounts of the catalyst, with no exposure to the atmosphere.
- A catalyst pre-mixer doses the catalyst in a blender where it is dissolved in the recirculation oil stream. This ensures the introduction of the catalyst powder to the oil occurs inside the vacuum reactor.
- A catalyst neutralizer, using either acid or water, to render the catalyst inactive.

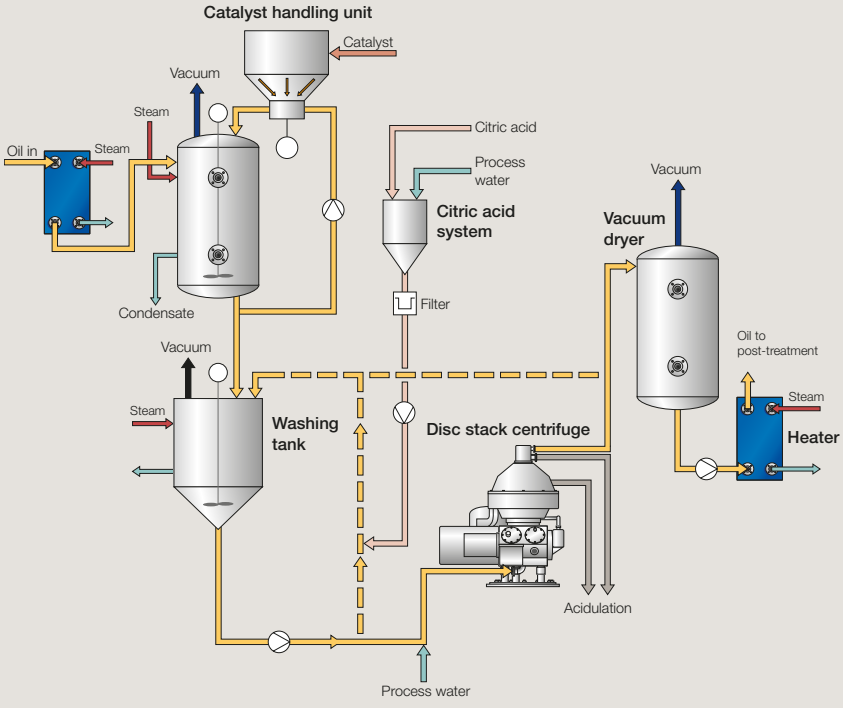
Other special Alfa Laval features include:

- Oil conditioning. Recirculating the hot oil to the reactor under vacuum conditions ensured that the oil has a low moisture content. This results in the best possible catalyst efficiency and consumption.
- Post-treatment equipment includes the Alfa Laval hermetically sealed earth transportation and dosing system and a post-treatment reactor with steam or mechanical agitation, designed for continuous or batch operation.

Because of the design of the components and the rigorous specifications used, Alfa Laval interesterification equipment keeps the consumption of energy and other utilities to a minimum, resulting in lower operating costs.

Alfa Laval disc stack centrifuge

Interesterification



A schematic diagram of the interesterification process (catalyst deactivated with water)

Expertise from a global a world leader in heat transfer, centrifugal separation and fluid handling

Process know-how

One of the key advantages of working with Alfa Laval to install, update and extend your fats modification systems is our extensive practical experience.

Alfa Laval's proven ability to design and configure a wide range of process variants to meet specific customer requirements can provide you with the benefits of a vast body of accumulated know-how.

Project implementation

Alfa Laval has a specialist group whose sole focus is the design and engineering of fats and oils projects. Our specialists have years of experience and an extensive, proven track record of plants designed, installed and in operation.

The process and engineering team also has constant access to the most recent technologies and solutions implemented by Alfa Laval all over the world. This means you benefit directly from Alfa Laval's renowned know-how in the fields of thermal engineering, separation technologies and fluid handling, and from the latest breakthroughs in other related industrial processes.

Engineering for automation

The automation of key plant operating processes – either wholly or in part – makes it possible to achieve new levels of flexibility when you need rapid, reliable resettings and adjustments to meet new specifications. Alfa Laval can provide you with the exact degree of automation you need to meet your particular requirements.

Alfa Laval provides a wide range of straightforward, easy-to-operate control and monitoring systems, which easily integrate with existing plant control systems.

Engineering services

Alfa Laval provides a wide range of supplementary engineering services that help ensure that your new installation comes on line as quickly and efficiently as possible.

We can also provide you with considerable savings by ensuring full compliance with the relevant national and international regulations for design codes, safety procedures and best engineering practices.

Alfa Laval engineering services include:

- installation design in full accordance with international standards
- installation supervision
- commissioning and start-up
- operator training
- documentation
- operational, maintenance and service support.

Essential palm oil

Solutions for reducing 3MCPD esters and glycidyl esters from palm oil processes

Balancing food safety, economy and performance

Regulatory guidelines for palm oil processing are evolving as health risks associated with the formation of 3-monochloro-1,2-propanediol, its esters (3-MCPDE), and glycidyl esters (GE) during refining come to light. As a result, Alfa Laval is working with palm oil producers to safeguard public health as well as the productivity of the palm oil plants worldwide.

Innovative processing solutions

Based on proven technologies, Alfa Laval's innovative solutions help palm oil producers mitigate process contaminants while ensuring sound operating economy as well as the taste, odour, color, acidity, and stability of palm oil.

Prepared for future regulations

Alfa Laval is working to ensure that palm oil producers can meet future regulatory requirements while maintaining premium quality palm oil. There are four focal points in palm oil processing where significant reductions of 3-MCPDE and GE can be achieved.

- D3 PRO Oil clarification - The Alfa Laval D3 PRO Oil Clarification System eliminates the use of dilution water in the mill, which rids the process of a major source of chlorine that contributes to 3-MCPDE formation.

- Neutralization - The Alfa Laval Combi Mix Neutralization Process produces refined oils with 3-MCPDE and GE content of less than 0.5ppm.

- Crude palm oil washing - The Alfa Laval Crude Palm Oil (CPO) Washing Process can be installed immediately after D3PRO Oil Clarification Process or prior to the physical refining process.

- Dual-strip technology - The Alfa Laval dual-strip technology can include the option of cooling after pre-stripping. This enables the retention, or heat bleaching, to be carried out at temperatures below 230°C (or as low a temperature as the color requirements will allow) to minimize the formation of GE, while deacidification takes place in Pre-stripper under elevated temperature but within short period.

Secure low total cost of ownership

Alfa Laval solutions not only reduce 3-MCPDE and GE from refined palm oil, but also help minimize yield loss for palm oil producers. These reliable energy-efficient, low-maintenance solutions deliver top performance, operating reliabitiliy and premium quality. This translates into low total cost of ownership and true peace of mind.

Professional, competent partners

With more than 50 years of industry experience, Alfa Laval has a deep understanding of palm oil processes and vast expertise in addressing the challenges that palm oil producers face. Rest assured, we put Alfa Laval R&D resources, materials technology and specialist know-how to work for you – from processing fresh fruit bunches all the way through to quality refined palm oil.

Close to you

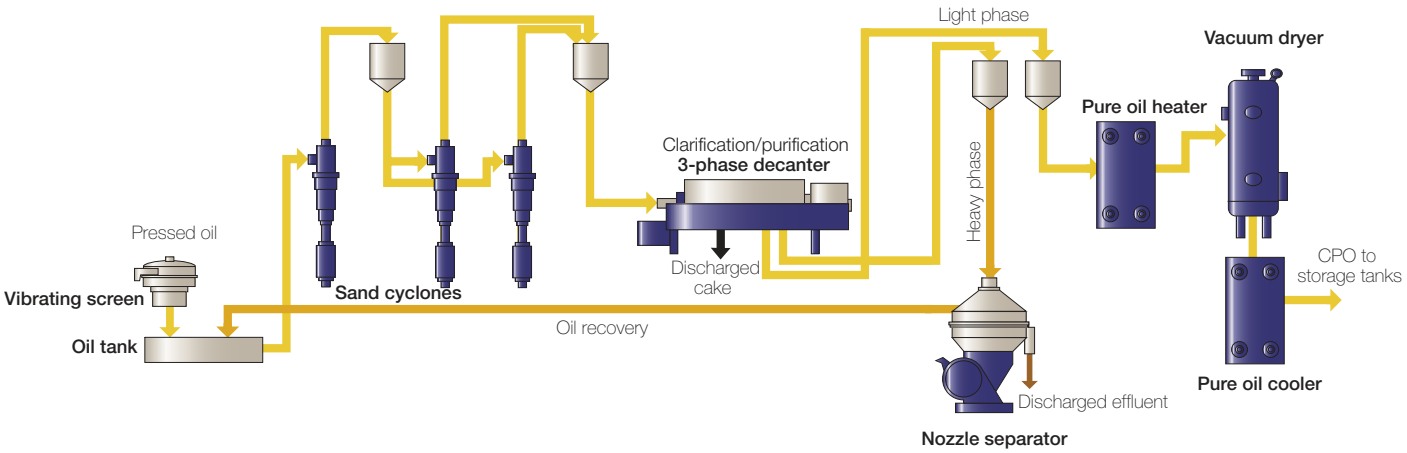
With the Alfa Laval 360° service portfolio, support and service are always close at hand. Our global reach and local presence ensure that we can maximize the uptime, performance and operating efficiency of your Alfa Laval equipment throughout its life cycle.

Wherever you are, Alfa Laval's palm oil competence centres, sales offices and service centres are never far away

Mitigation starts from source

From milling to refining

Alfa Laval D3 PRO Oil Clarification System



Alfa Laval D3 PRO Oil Clarification System

Using the Alfa Laval D3 PRO Oil Clarification System minimizes the contaminants by eliminating one of the major sources of chlorine: water added to the mill process lines to dilute pressed crude palm oil.

Alfa Laval D3 PRO Oil Clarification System does not require any dilution water. Unlike conventional clarification systems where, depending on availability, water is sourced from tube wells, rivers or ponds, the Alfa Laval clarification system sources process water from:

- Water present in the fresh fruits
- Water adsorbed to the bunches during steam sterilization
- Water added during pressing to facilitate drainage of the press liquor
- Live steam heating

The Alfa Laval D3 PRO separates oil from water and non-oily solids present in the fruits.

Typically, approximately 20% less water is required for each tonne of fresh fruit bunches processed compared to the current practice.

The system operates on crude oil using a three-phase decanter with a nozzle disc stack separator for final recovery. No large continuous settling tank is required to achieve low oil content in the underflow.

D3 PRO in action

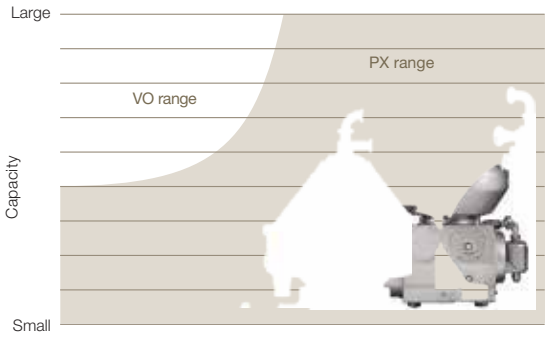
Since 2009, Alfa Laval D3 PRO has been adopted by numerous crude palm oil mills across the world.

D3 PRO allows you to

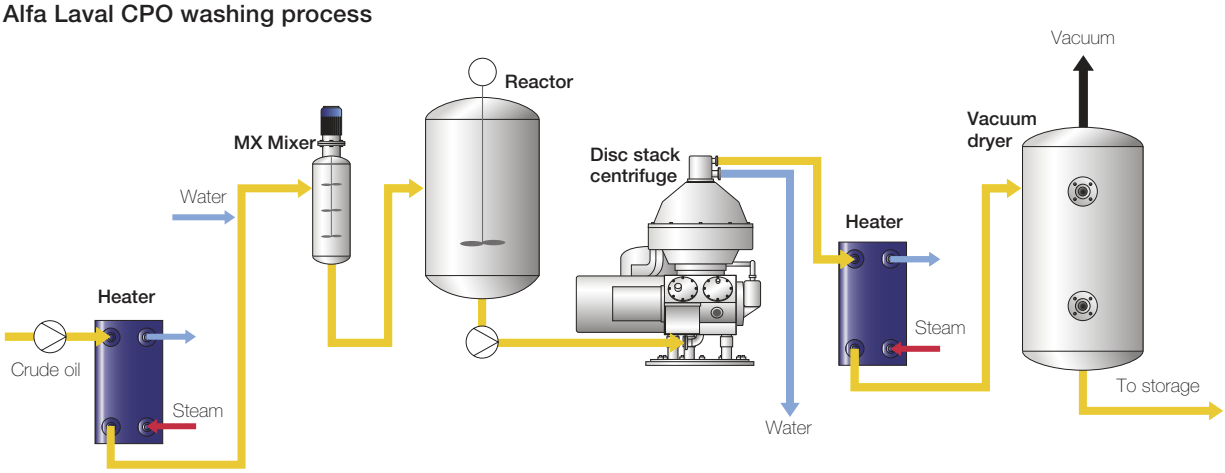
- Recover lost oil for higher yields and profit
- Separate without dilution water
- Reduce effluent by up to 30%
- Create a light phase with no need for additional purification
- Operate at high capacity
- Create cake for other income sources such as fertilizer
- Save space and money by eliminating a continuous vertical settling tank from your process
- Reduce water, energy and labour cost.
- Minimize maintenance and man-hours
- Separate crude palm oil 24 hours a day
- Consistent separation and oil quality
- No unnecessarily long holding time and exposure to oxidation

Alfa Laval high speed separators

The Alfa Laval VO and PX ranges are self-cleaning high speed separators designed for neutralization and oil washing. Both are robust and easy to maintain targeting different capacity. The Alfa Laval PX range with its semi-hermetic design is equipped with the unique Alfa Laval Centrizoom™ adjustable paring disc. This enables you to deal with a wide range of gums and soapstocks, and undertake rapid, variable adjustment via remote control. It also reduces energy consumption dramatically.



Alfa Laval CPO washing process



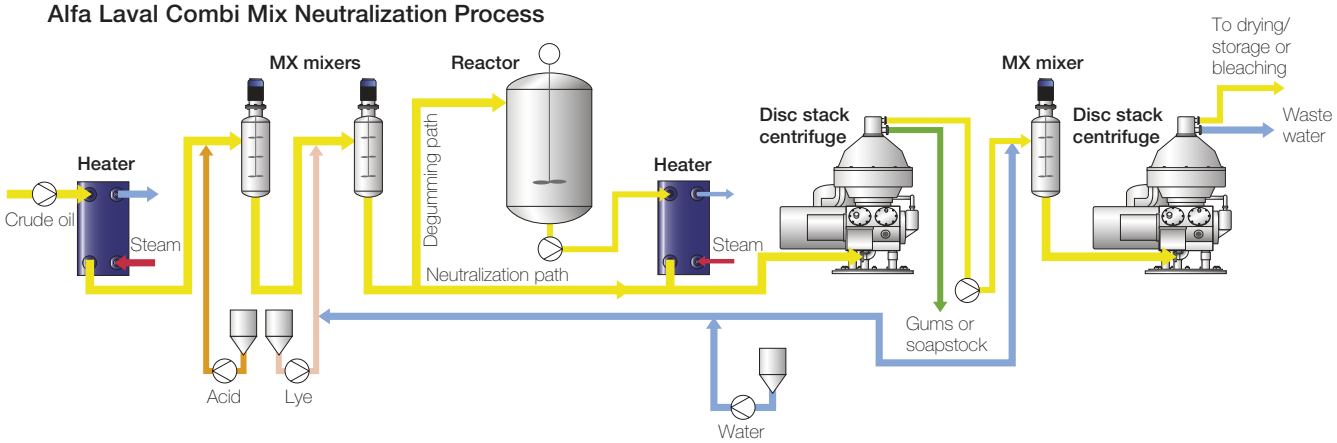
Alfa Laval Neutralization

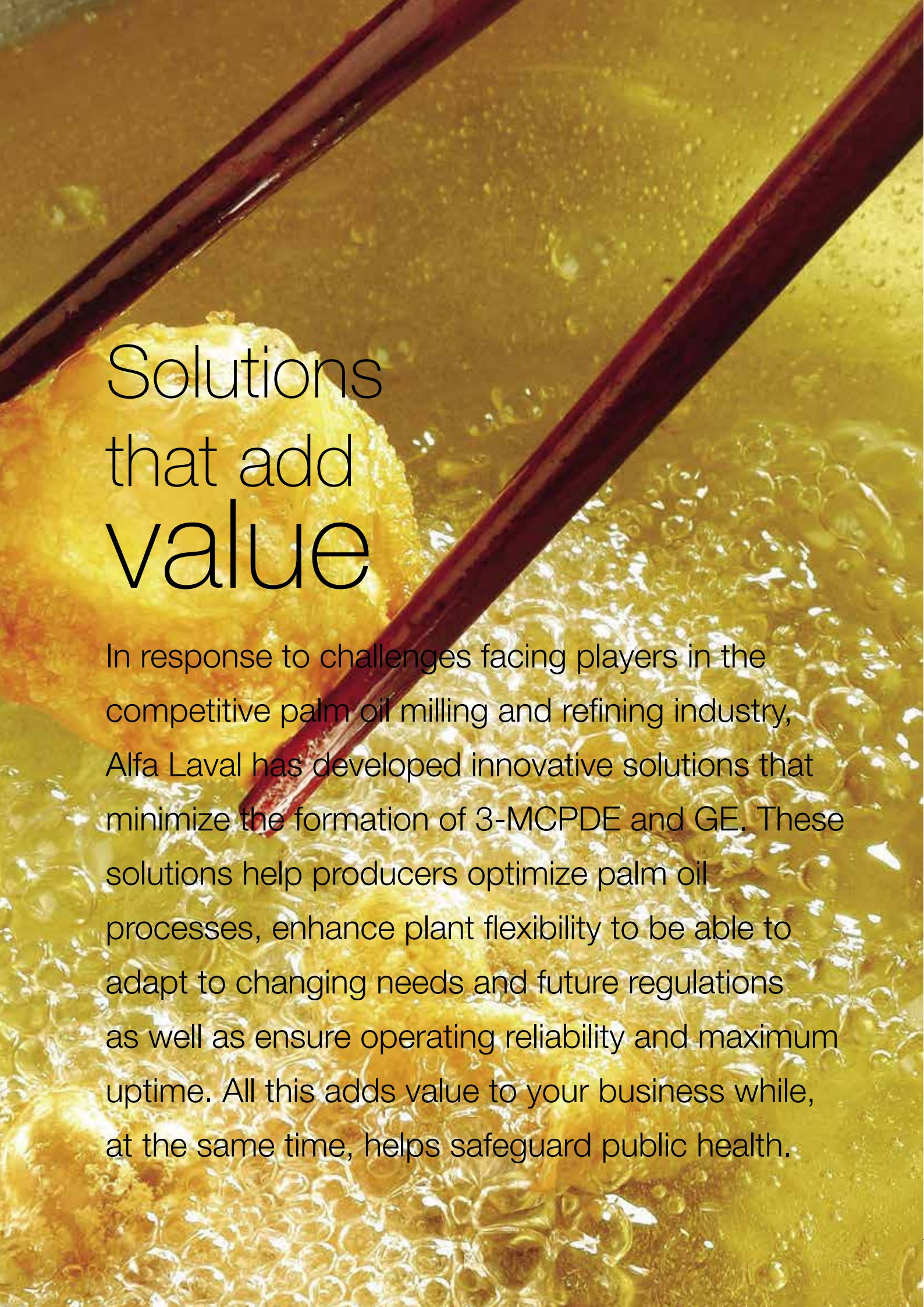
Neutralization using caustic soda is widely recognized as an effective way to purify crude oils. It also has the advantage that the soapstock formed by this process also encapsulates other impurities such as sugar, pigments and trace metals.

Neutralization is generally carried out using a continuous disc stack centrifuge. Once neutralization has been completed, the oil is washed. The wash water is then removed using disc stack centrifuges, and the oil is dried in a vacuum dryer.

Alfa Laval palm oil neutralization only requires short contact time. This is because palm oil has very low gums but high content of free fatty acids. Due to our vast palm oil process experience, Alfa Laval has been able to optimize acid dosing as well as accurate dosing of caustic soda with optimum caustic strength. This experience has enabled Alfa Laval to facilitate palm oil neutralization with minimum yield loss while enabling the production of premium oil with good economy.

Alfa Laval Combi Mix Neutralization Process





Solutions that add value

In response to challenges facing players in the competitive palm oil milling and refining industry, Alfa Laval has developed innovative solutions that minimize the formation of 3-MCPDE and GE. These solutions help producers optimize palm oil processes, enhance plant flexibility to be able to adapt to changing needs and future regulations as well as ensure operating reliability and maximum uptime. All this adds value to your business while, at the same time, helps safeguard public health.

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.in