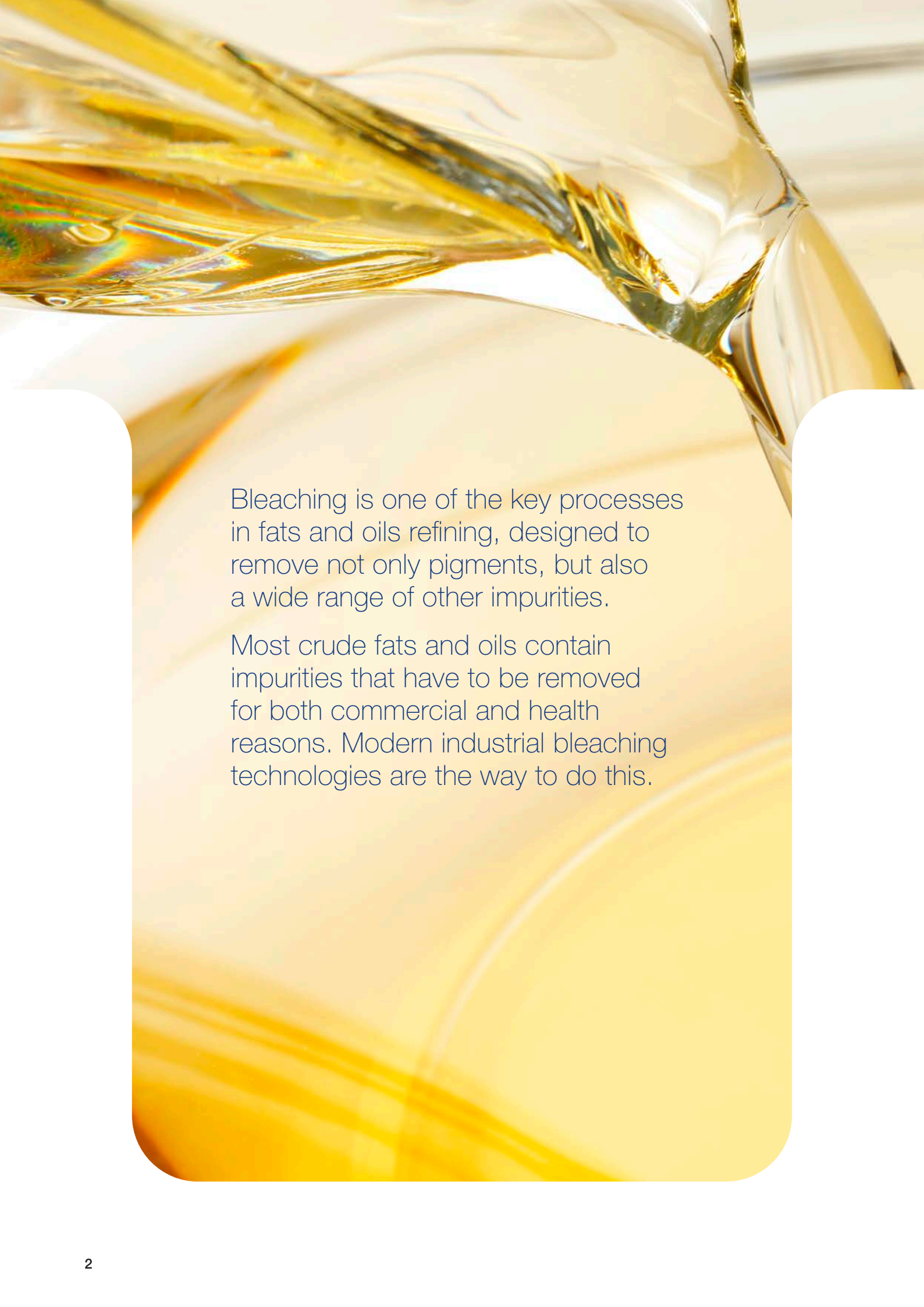


The background of the page is a photograph of several glass bottles filled with a bright yellow liquid, likely oil. The bottles are arranged in a row, with the one in the foreground being in sharp focus and the others in the background being blurred. The lighting is soft, highlighting the texture of the glass and the clarity of the liquid.

# 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:

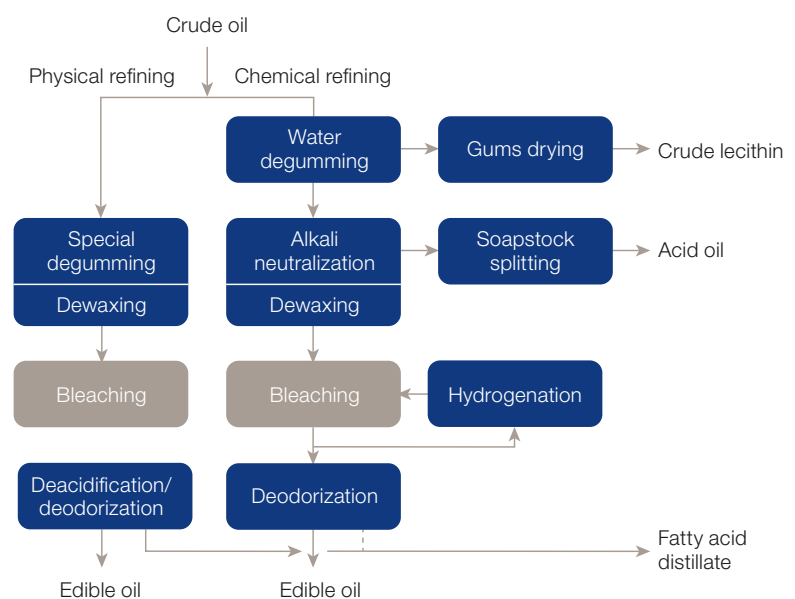
- remove certain pigments such as carotinoids and chlorophyll
- decompose and partially remove oxidation products
- remove contaminants such as soaps and trace metals
- remove traces of phosphatides
- remove polycyclic aromatic hydrocarbons and other pollutants.

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.

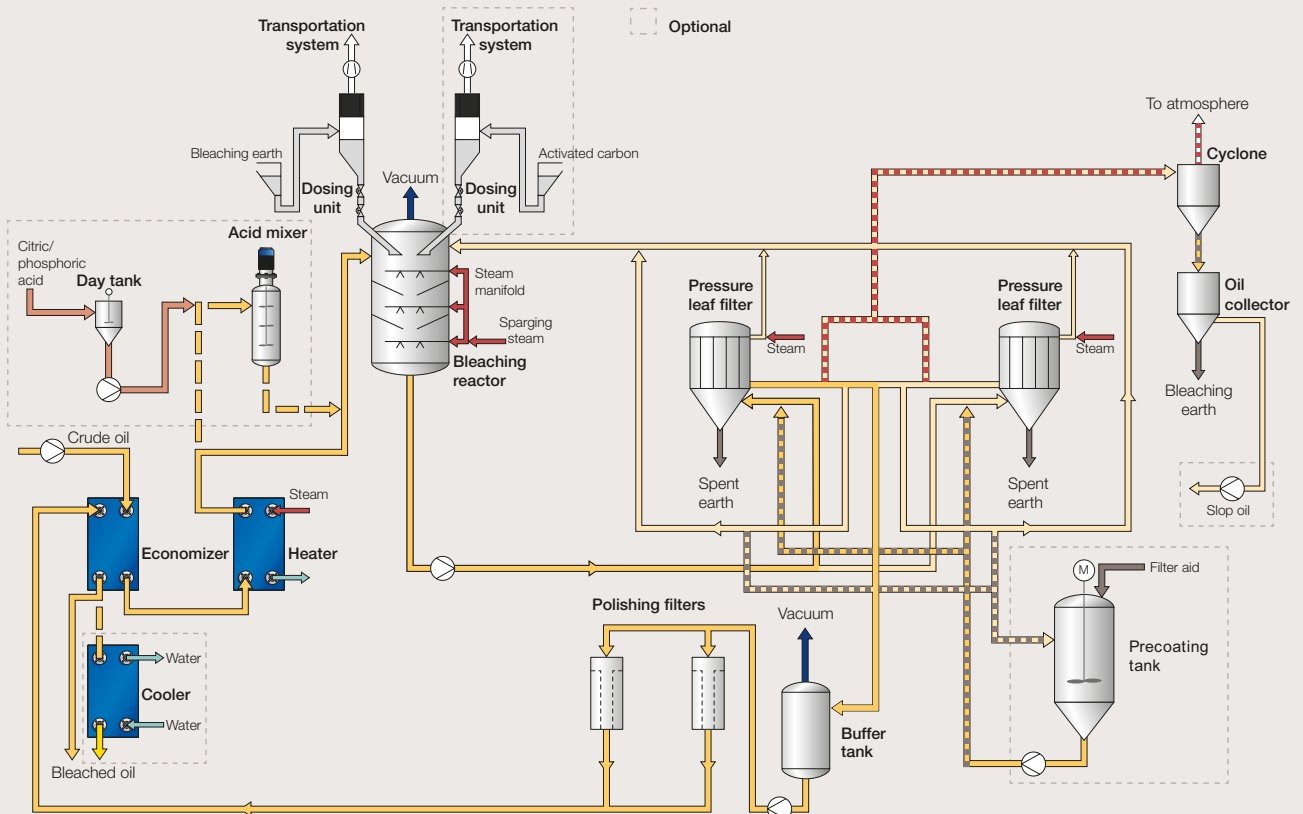
After bleaching, the bleaching agent is normally removed using pressure leaf filters. Naturally, the filter cake that accumulates here still contains oil. Much of this can be recovered by

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

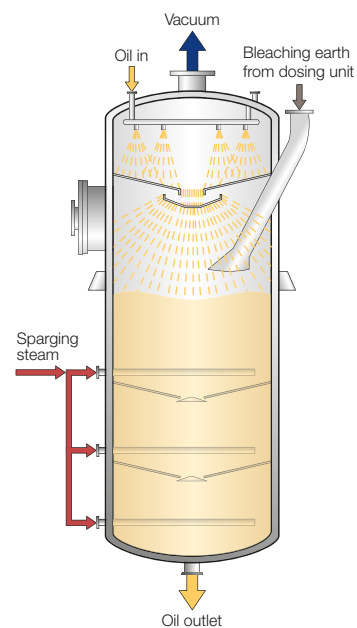
As the name implies, wet bleaching is a bleaching process in which water is added to the oil while it is in contact with the bleaching agent in the bleaching reactor.

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.

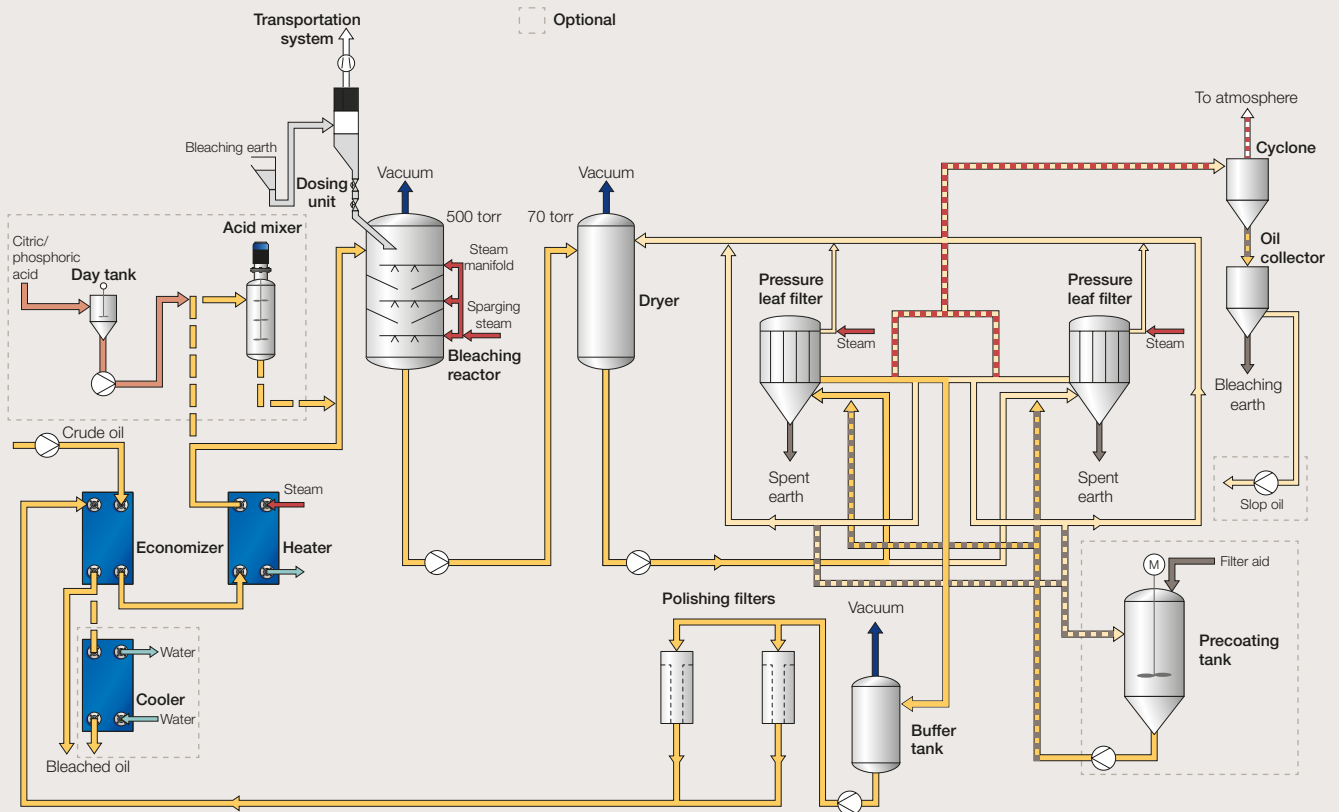


The reactor is divided into three compartments to ensure uniform reaction times and avoid oil flow short cuts inside the reactor.

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.

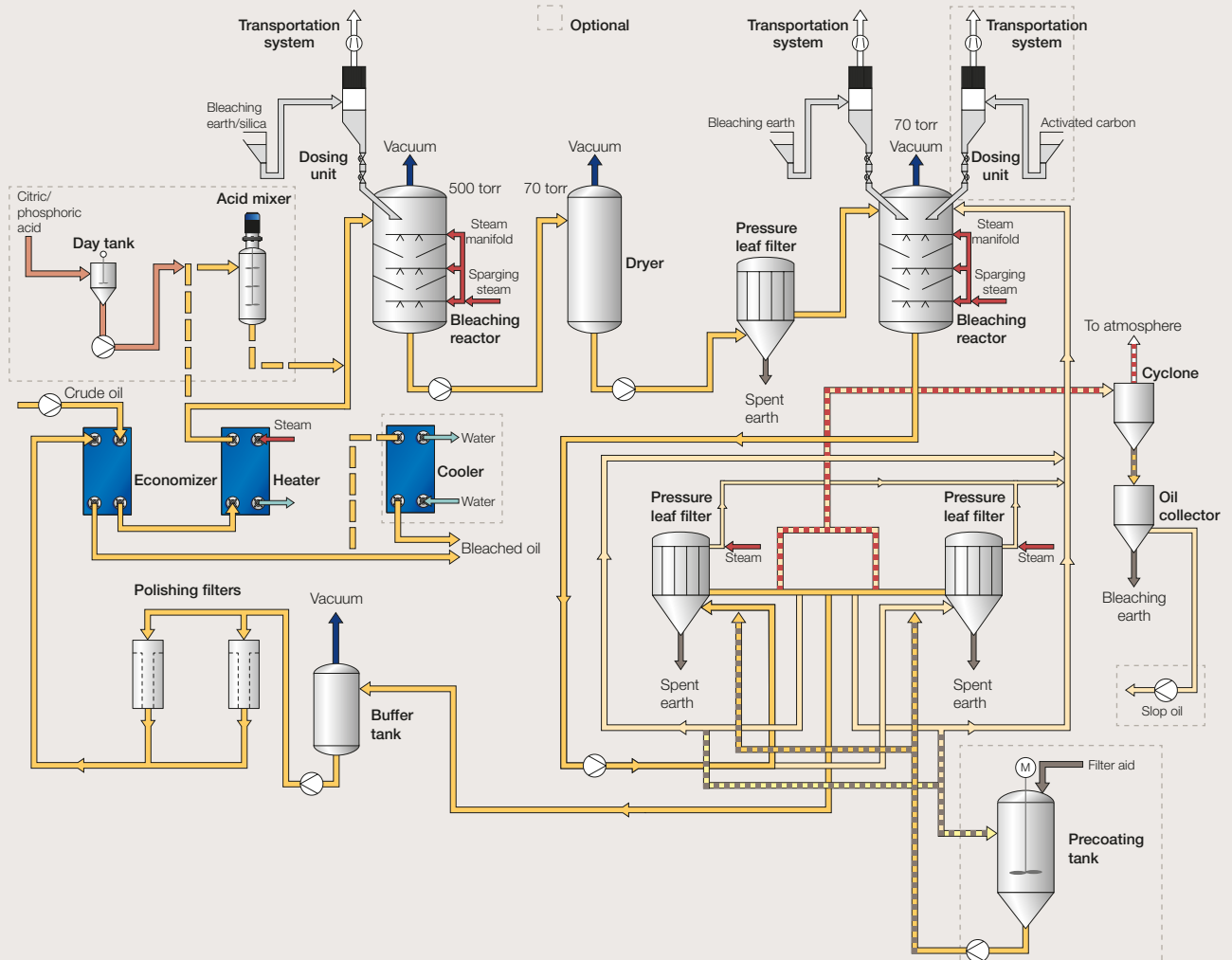
At the second stage fresh adsorbent is then added to the treated oil until a new state of equilibrium is reached. This oil then passes through a second filtration stage.

## 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  $\pm 0.03\%$  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.



#### **This is Alfa Laval**

Alfa Laval is active in the areas of Energy, Marine, and Food & Water, offering its expertise, products, and service to a wide range of industries in some 100 countries. The company is committed to optimizing processes, creating responsible growth, and driving progress – always going the extra mile to support customers in achieving their business goals and sustainability targets.

Alfa Laval's innovative technologies are dedicated to purifying, refining, and reusing materials, promoting more responsible use of natural resources. They contribute to improved energy efficiency and heat recovery, better water treatment, and reduced emissions. Thereby, Alfa Laval is not only accelerating success for its customers, but also for people and the planet. Making the world better, every day. It's all about *Advancing better™*.

#### **How to contact Alfa Laval**

Contact details for all countries are continually updated on our web site. Please visit [www.alfalaval.com](http://www.alfalaval.com) to access the information.

