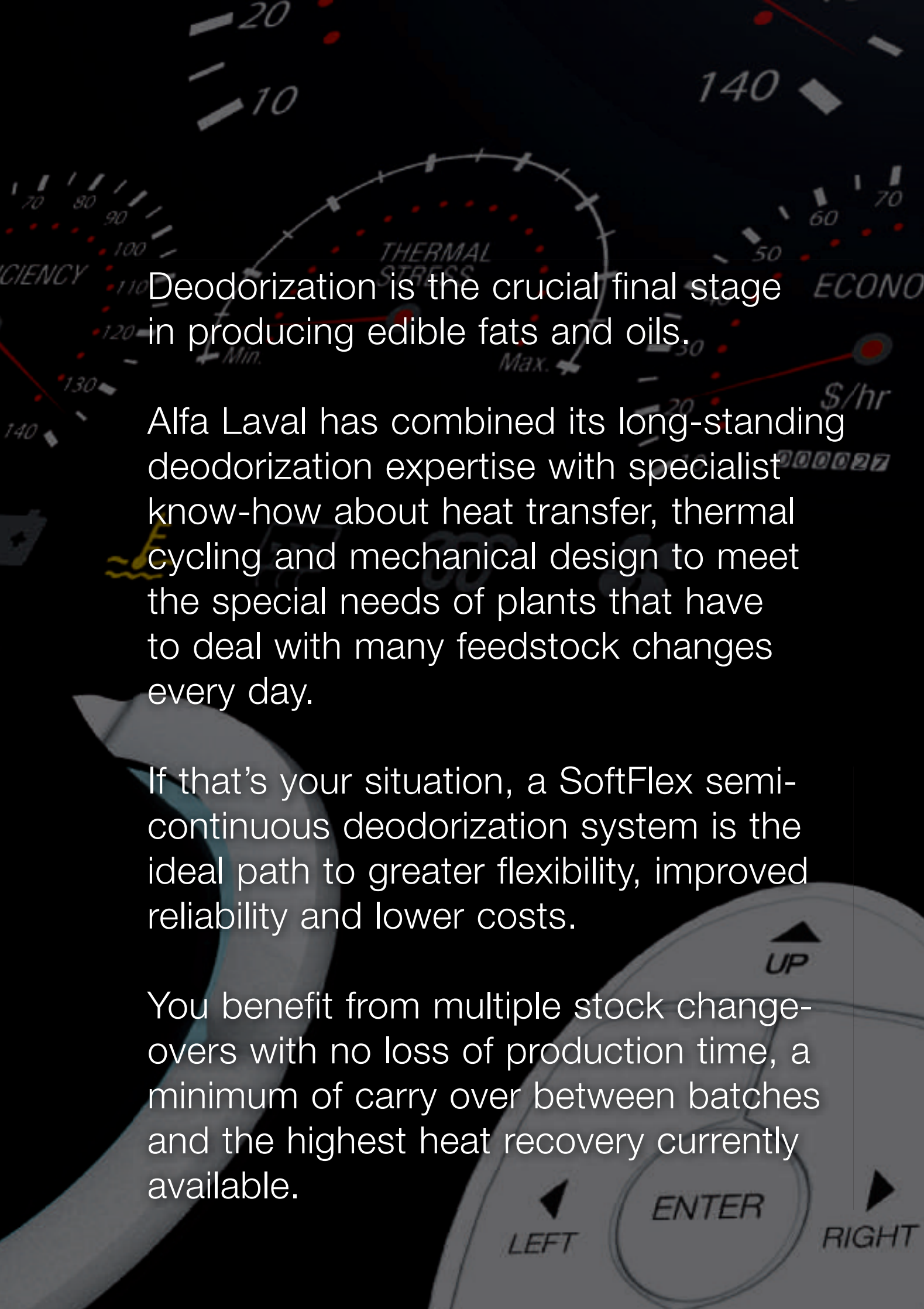




## A new degree of deodorization control

Alfa Laval SoftFlex™ semi-continuous deodorization systems





Deodorization is the crucial final stage in producing edible fats and oils.

Alfa Laval has combined its long-standing deodorization expertise with specialist know-how about heat transfer, thermal cycling and mechanical design to meet the special needs of plants that have to deal with many feedstock changes every day.

If that's your situation, a SoftFlex semi-continuous deodorization system is the ideal path to greater flexibility, improved reliability and lower costs.

You benefit from multiple stock change-overs with no loss of production time, a minimum of carry over between batches and the highest heat recovery currently available.

# Targeting your deodorization requirements

## Deodorization makes the difference

When processing edible fats and oils, deodorization is the crucial last step in removing any undesirable substances still present after the preceding processing stages. Such impurities can affect flavour, odour, stability and colour.

The most effective way to remove these impurities is by deodorization – a steam distillation process that takes place at very low pressure and relatively high temperatures. This provides a particularly effective combination of thermal decomposition and separation by stripping, which results in high-quality, stable oils.

## Continuous or semi-continuous

Alfa Laval is a world leader in the highly specialized field of processing edible fats and oils. We apply the most advanced technologies – often patented – in ways that set new benchmarks for the whole industry, and enable you to match your production configurations to changing market requirements.

Alfa Laval provides customers with a full choice between continuous and semi-continuous deodorization systems.

The well-proven SoftColumn™ deodorization system applies patented thin-film technology to continuous deodorization processes, and is best suited for set-ups where very few stock changes are required.

The new SoftFlex™ semi-continuous deodorization system applies improved thermal and mechanical designs to the deodorization process, and is specially designed for set-ups where a high number of stock changes are required.

## New benchmarks

Alfa Laval SoftFlex technology shifts the benchmarks for what you can achieve with high-quality semi-continuous deodorization.

The versatility of SoftFlex technology provides you with a choice between two main options:

- the type of heat transfer technology you wish to use
- the type of deacidification technology you wish to use.



Deodorization process choices	
SoftColumn continuous deodorization	SoftFlex semi-continuous deodorization
Up to 3 stock changes per day	Multiple stock changes each day
Continuous flow in and out	Separate batches held in each tray for a defined time
Long stock change time	Immediate stock changes

## The SoftFlex advantage

An Alfa Laval SoftFlex semi-continuous deodorization solution is the most effective deodorization set-up currently available for processing lines that have frequent stock changes, and where the focus is on:

- fast, easy changes between stock
- minimum cross-contamination between batches
- reduced energy consumption and lower fuel costs
- lower all-round environmental impact.



# Separate but together

The SoftFlex semi-continuous deodorization column consists of a series of separate trays, each serving a specific purpose in the process.

The oil on one tray is kept completely separate from the oil present on all the other trays. After a pre-set time (determined by the operator), the oil batch is gravity-fed from one tray to the next.

One possible SoftFlex column configuration, and the operations taking place on each tray, is shown on the opposite page (the numbers in the explanatory text correspond to the tray numbers in the column in the process flow diagram).

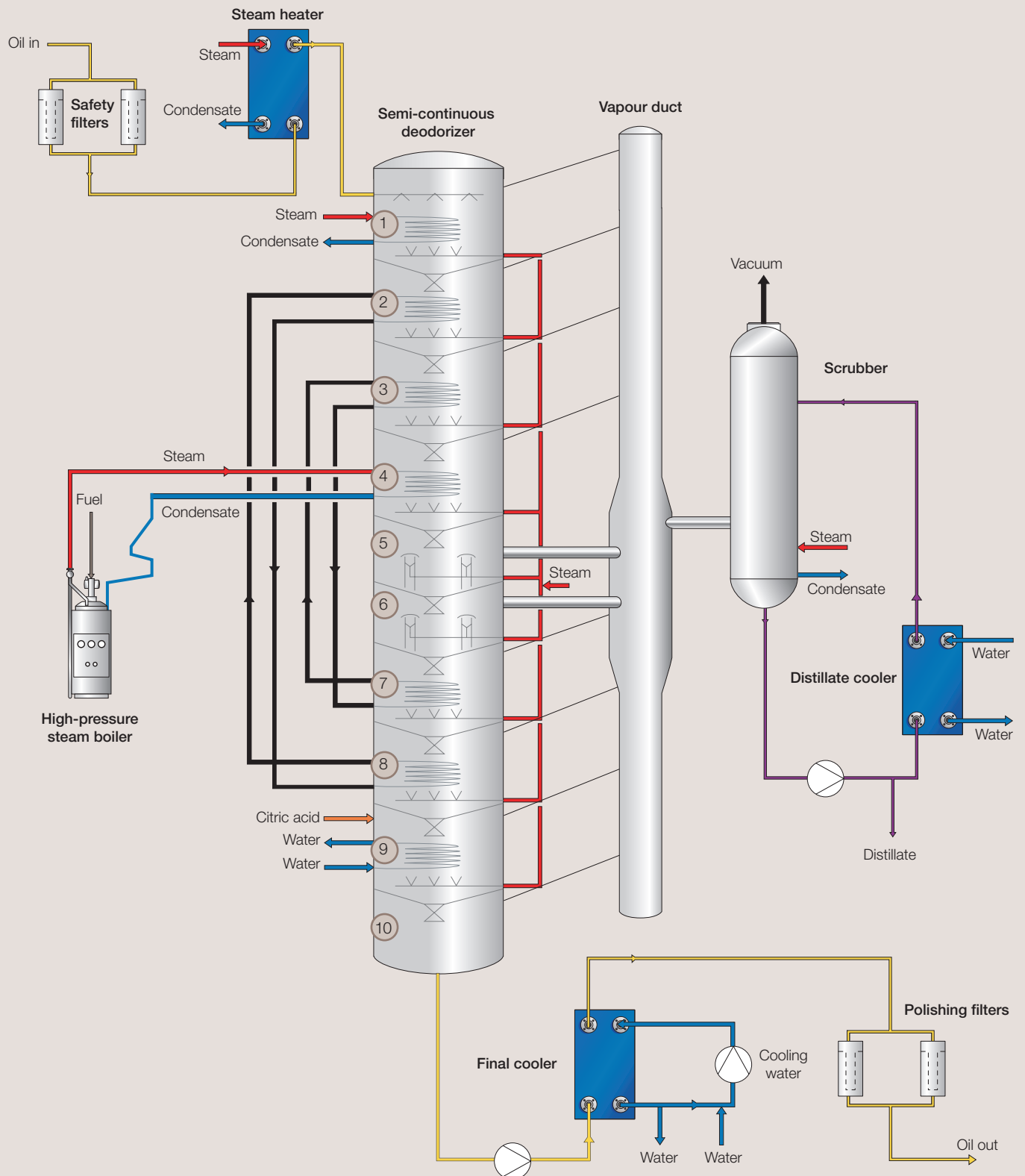
- 1 Deaeration – air is removed before the oil is heated to high temperatures in order to prevent oxidation. The tray is optionally equipped with a start-up heater to reduce overall start-up time.
- 2 Thermosiphon heat recovery – indirect (low-temperature loop) heat recovery with tray 8. Steam generated inside the coils of tray 8 while cooling the oil rises to tray 2, where it is condensed inside the coils while heating the oil. The condensate returns to tray 8 by gravity, thus creating a thermosiphon loop.
- 3 Thermosiphon heat recovery – indirect (high-temperature loop) heat recovery with tray 7. Steam generated inside the coils of tray 7 while cooling the oil rises to tray 3, where it is condensed inside the coils while heating the oil. The condensate returns to tray 7 by gravity, thus creating a thermosiphon loop.
- 4 Final heating – the oil is brought to final deodorization temperature using high-pressure steam.
- 5 Stripping/deodorization trays
- 6 – trays in which steam is injected into the oil using mammoth (steam-lift) pumps. These pumps recirculate the oil from the bottom up to the surface, to make sure that FFAs and other volatile compounds are removed effectively.
- 7 Thermosiphon heat recovery – the bottom half of the high-temperature loop with tray 3, where steam is generated by heat from the hot oil dropped from the stripping/deodorization trays.
- 8 Thermosiphon heat recovery – the bottom half of the low-temperature loop with tray 2, where steam is generated from hot oil.
- 9 Cooling tray – water is used to cool the oil to the desired temperature. Additional energy is normally recovered by generating either hot water or steam while cooling the oil.
- 10 Buffer tray – to facilitate continuous discharge of oil from the column in cases when there is no stock change between each tray. At stock change, this tray is completely emptied.

## SoftFlex configuration options

A range of options is available to make sure your system is customized to your specific needs. These include:

- number of stripping trays/total deodorization time
- packed-bed stripping tray
- heat transfer as U-tubes or spiral coils
- single or double thermosiphon heat recovery loops
- internal or external vapour ducting
- double scrubber
- distillate segregation
- cooling tray heat recovery options.

# Typical SoftFlex semi-continuous deodorization process flow diagram and column configuration



# The heat transfer decision

The SoftFlex semi-continuous deodorization system enables you to choose between several different configurations. The first decision on which to focus is the type of heat transfer surface.

## Traditional spiral coils

Spiral coils (also known as pig-tails) are the technology normally used for heat transfer in semi-continuous deodorization processes.

However, the design of spiral coils – as well as the methods used to manufacture them – often makes them susceptible to thermal fatigue, on account of the cyclical nature of semi-continuous deodorization. Nevertheless, spiral coils can still be used effectively in many contexts.

## U-tubes\*

The SoftFlex semi-continuous deodorization system is also available with U-tubes for all heat transfer areas. The special Alfa Laval U-tubes available for the SoftFlex column are highly resistant to thermal fatigue because they can expand freely along their length. This unique Alfa Laval design results in a predicted service life up to 20 times longer than with traditional spiral coils.

With U-tubes, each tray has a heat transfer area that is up to 30% greater than with spiral coil solutions. This has a direct impact on heat recovery effectiveness, and results in lower energy consumption for the final heating of the oil.

Furthermore, the special way Alfa Laval installs U-tubes in the SoftFlex column means the installation height of the U-tube design is notably lower than for the spiral coil design.

\*Patent pending

This makes it possible to operate with a lower oil height, which increases flexibility in operation and turn-down in batch size selection.



SoftFlex installation at the Bunge plant in São Paulo, Brazil.

## Heat transfer configurations in SoftFlex deodorization system

Spiral coils	U-tubes
Conventional design using spiral coils for all heat transfer surfaces	Improved Alfa Laval design using U-tubes for all heat transfer surfaces
Familiar set-up that is well known in the deodorization industry	More effective heat recovery
	Lower fuel consumption
	Predicted service life up to 20 times longer
	Lower oil level due to lower installed height of U-tubes





Close-up/cross-section of a tray fitted with spiral coils.



Close-up/cross-section of a tray fitted with U-tubes.

Typical heat recovery in different configurations

No. of thermosiphons	Spiral coils	U-tubes
1	41	44
2	64	68
% of heat recovery		

Additional heat recovery

It is possible to achieve additional heat recovery in the cooling tray. If a single-thermosiphon configuration is used, low-pressure steam can be produced for use elsewhere. If a double-thermosiphon configuration is used, hot water can be produced.



Typical SoftFlex column, showing selected heat transfer trays.



# The deacidification decision

The SoftFlex deodorization system offers different deacidification technologies to provide you the most suitable balance between effective removal of volatiles and other important factors like cross-contamination and running costs.

### Mammoth pump trays

The conventional method of deacidification in semi-continuous deodorization is by mammoth (steam lift) pumps. These pumps turn the oil around many times while it is on the tray, thus bringing the oil from the bottom of the tray to the top, where it is exposed to the best vacuum. Here the FFAs and other volatiles are removed, with the aid of the same steam used to circulate the oil. This solution is still recommended when the very minimum of product cross-contamination is required.

### Packed-bed trays

In many cases, however, slightly more product cross-contamination can be acceptable in order to greatly increase stripping efficiency, and thus reduce the consumption of stripping steam.

For such situations, Alfa Laval provides an innovative solution for deacidification in which one – or all – of the mammoth pump trays are replaced by a packed-bed stripping section. The packing operates within the batch sequence, and the oil batch passes through the packing within the predetermined cycle.

The packing section results in a considerable reduction in the amount of stripping steam required for both chemical and physical refining. This steam reduction can be as much as 40%, which reduces vacuum operating costs by a similar amount.

### Measurable benefits in physical refining

	Typical required stripping time	Typical required stripping steam
Mammoth pump	60 minutes	1.5–2.0%
Packed-bed section	40 minutes	0.8–1.2%

### Deacidification configurations in SoftFlex deodorization system

Mammoth pump trays	Packed-bed trays
Traditional design with mammoth pump trays for deacidification	One mammoth pump tray replaced with a packed-bed stripping tray
Familiar set-up that is well known in the deodorization industry	Up to 40% reduction in steam consumption
Best solution when minimal cross-contamination is essential	Easier to undertake physical refining of the oil
	Greater refining capacity because stripping time is no longer a limiting factor







An example of SoftFlex column incorporating packed-bed section and mammoth pump tray technologies.



Close-up/cross-section of a packed-bed section.



Close-up/cross-section of a mammoth pump tray.

#### Advantages in physical refining

Physical refining of oils with high FFA content takes a very long time if only mammoth pump trays are used. This approach also limits processing capacity and requires a lot of stripping steam.

By contrast, using packed-bed stripping means the time needed to remove volatiles is no longer the limiting factor for the tray cycle.

This means shorter processing times, greater throughput and lower steam consumption.

# Benefit from Alfa Laval design know-how

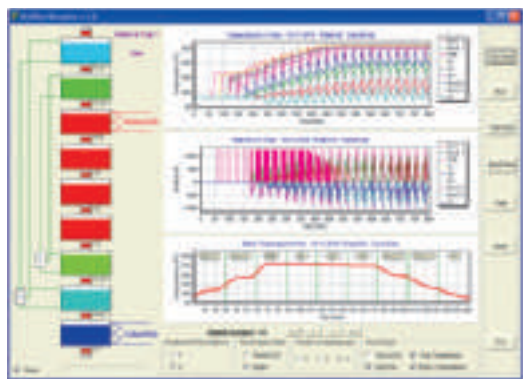
## Advanced modelling tools

Alfa Laval uses state-of-the-art modelling tools when designing SoftFlex deodorizer components, to ensure optimum performance, reliable operation and a long service life.

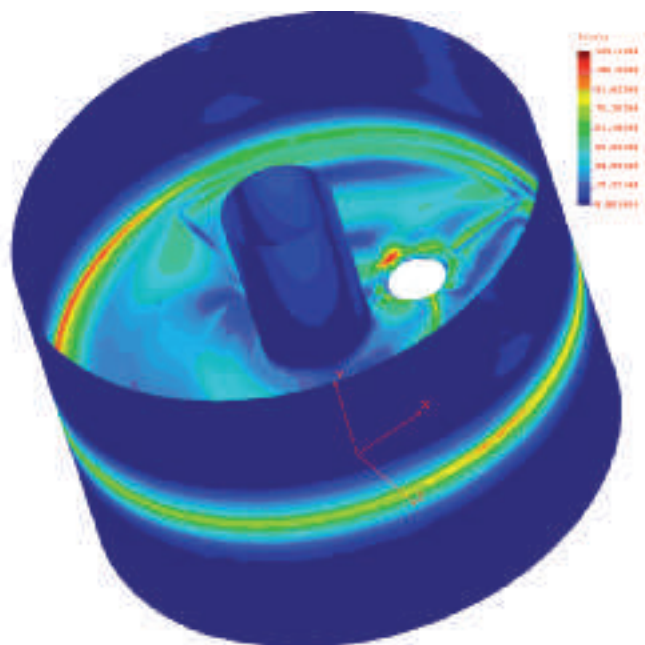
## Heat transfer optimization

Heat recovery plays a major role in deodorization operating costs. Alfa Laval has therefore developed special software to simulate the heat transfer performance that can be achieved under different design and operating conditions.

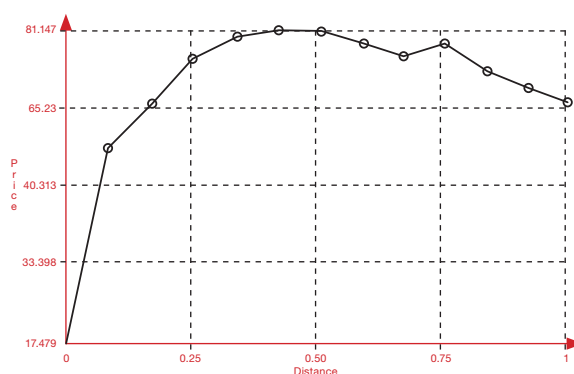
This software also makes it possible to simulate the start-up situation, and calculates the thermal stresses to which each part of the equipment is subjected.



Output from simulation of a specific vessel configuration and process conditions. Curves show tray temperature profiles, oil batch temperature profiles and heat fluxes.



3D plot of the thermal stresses, showing total membrane stress due to cyclic operation.



Stress plot from CosmosM v 2.95 software related to specific nodes in the 3D model above.

## Thermal stress analysis

The cyclic nature of deodorization operations places high demands on the equipment's mechanical resistance to temperature variations.

Advanced finite element analysis is used as an integrated and iterative part of SoftFlex design processes to identify the critical points and how they can be improved on. Due to the high degree of

design customization in each installation, every single deodorizer vessel undergoes this procedure.



# The power behind the product

## 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. Our customer service consultants are on call 24/7 to provide you with all the help and guidance you may need.

Full control over the entire supply chain associated with Alfa Laval equipment means we can provide you with prompt responses, excellent availability and lead times that are second to none. And our expertise ensures that any service work is carried out with the absolute minimum of disturbance to your operations.

## Know-how when needed

Alfa Laval service is based on knowledge and expertise obtained from years of experience working with customers that focus 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. Alfa Laval service packages ensure rapid turnarounds, extend equipment life and reduce unplanned downtime. The aim is to relieve you of maintenance and service burdens, so you can focus on the details of your processes and your business.

## Engineering services

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

Alfa Laval provides supplementary engineering services that 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 that complies with 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.



SoftFlex installation at the Bunge plant in São Paulo, Brazil.



### Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineered solutions. Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

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

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

### How to contact Alfa Laval

Up-to-date Alfa Laval contact details for all countries are always available on our website at [www.alfalaval.com](http://www.alfalaval.com)

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