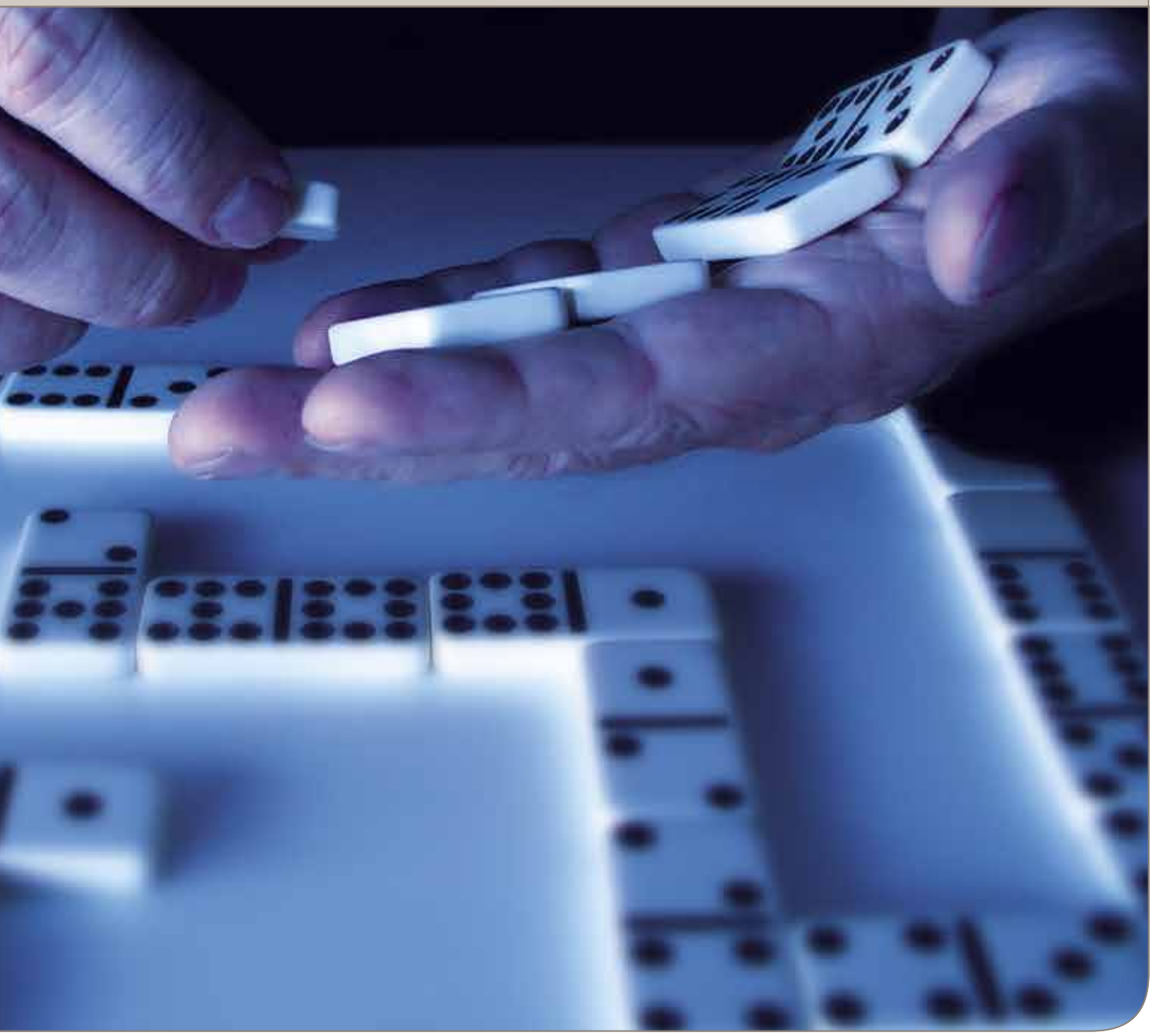
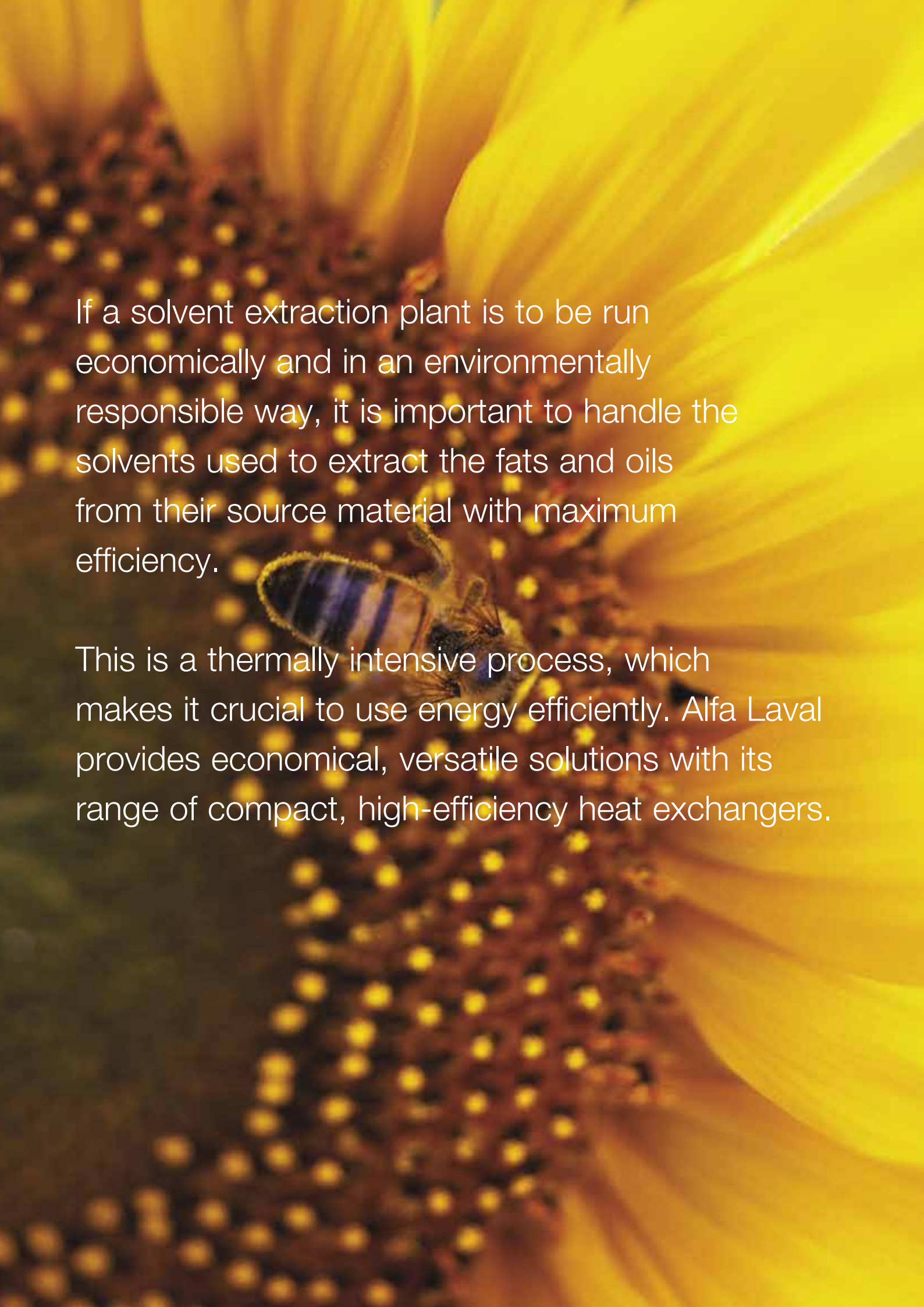
Laying down the right combination

Recovering solvents from fats and oils processes





If a solvent extraction plant is to be run economically and in an environmentally responsible way, it is important to handle the solvents used to extract the fats and oils from their source material with maximum efficiency.

This is a thermally intensive process, which makes it crucial to use energy efficiently. Alfa Laval provides economical, versatile solutions with its range of compact, high-efficiency heat exchangers.

The benefits – pure and simple

Alfa Laval heat exchangers can improve condensation and evaporation in solvent processes, irrespective of make and capacity of the plant.

Expanding plant capacity
The equipment in an extraction plant always has an optimum operating profile. As soon as the production levels anywhere in the processing chain exceed these parameters, bottlenecks start to occur. These cause a general imbalance in the system, which results in higher energy usage and/or higher solvents losses.

Alfa Laval heat exchanger solutions are the key to solving these imbalances by making it simple to boost the evaporation and condensation capacities of any part of the plant. Improving the way these thermal duties are carried out re-establishes the balance in the plant's processing activities, with important financial benefits.

Improving heat recovery
The amount of energy recovered in the first-stage evaporator, the DTDC hot gas/miscella economizer, drops as soon as capacity is increased and the heat transfer area thus becomes insufficient. This means more evaporation is required in subsequent stages. Alfa Laval evaporators are ideal for boosting this capacity and returning energy recovery levels to figures that are as good as new or even better.

Improving solvent recovery
Solvent recovery levels can be improved in most circumstances. Compact heat exchangers make it possible to boost recovery in two ways. Firstly, Alfa Laval systems enable very close temperature approaches, which minimize the amount of non-condensable gases that are passed on to the vapour scrubbing system. This means each individual condenser is capable of condensing more solvent than a corresponding shell-and-tube unit, resulting in a lower overall load on the vapour scrubbing system.

Secondly, a plate heat exchanger can be used to cool the mineral oil in the vapour scrubbing system more effectively, giving it a larger absorption capacity.

Replacing corroded units
Shell-and-tube heat exchangers are usually made of carbon steel. This means that corrosion always becomes a problem sooner or later, even with high-quality water. The compactness and efficiency of Alfa Laval heat transfer solutions make it possible to use stainless steel, titanium or other materials for all heat transfer areas, and to do so in a cost-effective way that makes them an ideal solution for replacing corroded units.

New plants
Compact heat exchangers are more efficient, easier to maintain and more versatile than traditional heat exchangers. Including such Alfa Laval equipment in the specifications for a new extraction plant means lower construction and installation costs and much less piping.

And when the time comes to increase plant capacity, it is an easy, straight-forward matter to upgrade existing compact heat exchangers.

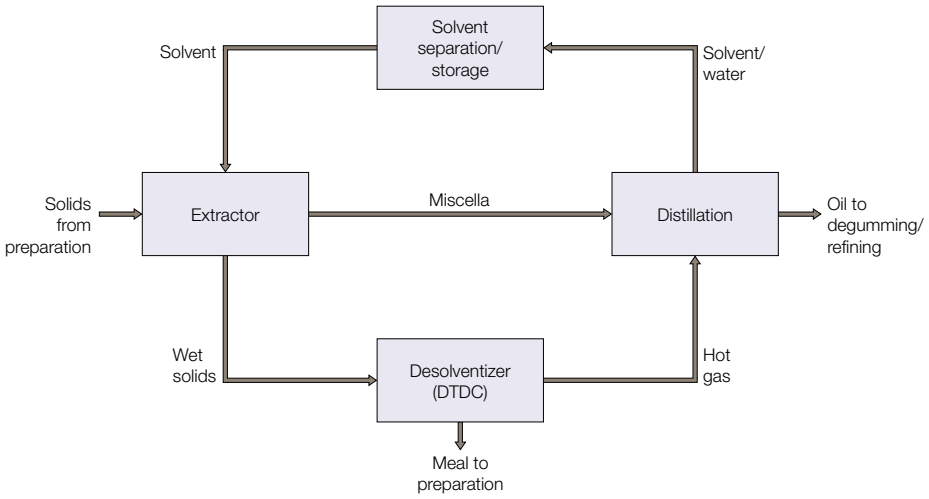
The basic principle behind solvent recovery

Solvents are used to extract fats and oils from many raw materials. The solvent most commonly used is hexane, a toxic substance, that must be recovered to the greatest extent possible for reasons of operating economics, environmental responsibility and general safety.

The basic processing principle

To prepare an oil seed for solvent extraction, a series of operations are carried out to expose the part of the seed that contains the oil. The solids that result from this preparation are transported to the extractor where they are brought into contact with the solvent. Two flows thus leave the extractor – the solids and the solvent/oil miscella. Solvent must be recovered from both streams.

Solvent recovery overview



The solids are typically processed in a unit called the desolventizer (DTDC), whose main function is to flash the volatile solvent from the solid phase by use of direct steam injection. The vapour leaving the DTDC must be cleansed and condensed.

The miscella flow that leaves the extractor goes to the distillation process. This normally takes place in three stages, including two evaporators and one distillation column. The hexane is removed from the oil in the distillation system, and the oil thereby concentrated to nearly 100%.

All condensed hexane is sent to the solvent separation/storage vessel, where hexane is separated from water and sent back for reuse in the process. The crude oil is then sold or refined still further. Any remaining exhaust vapour from the system is sent on to a vapour scrubbing system.

The economics of a solvent extraction facility thus depend largely on the investment cost and operating efficiency of the solvent recovery system. Making the right choice regarding the heat exchangers in this system is, in fact, a key to efficiency and profitablility.

Alfa Laval is able to bring the benefits of all our heat exchanger know-how, experience and technology to bear on meeting solvent recovery needs.

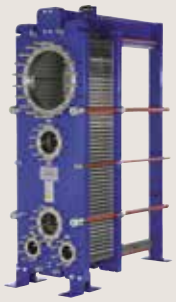
Alfa Laval heat exchangers make it possible to

- **save money**
  Unique designs provide substantially higher thermal efficiency than traditional shell-and-tube units, which means less heat transfer area is needed. This also makes it financially viable to build the heat exchangers in stainless steel, titanium or special alloys.

- **save space**
  The compact design of Alfa Laval heat exchangers means that transportation, erection and installation costs are drastically reduced compared with shell-and-tube units. When designing and building a new extraction plant, the floor space needed is less and the loads vastly reduced. In an existing plant, minimal installation modifications are required.

- **reduce maintenance**
  Most of the heat transfer surfaces are easily accessible for cleaning by simply opening or pulling apart the unit. The special Alfa Laval heat exchanger designs also create high turbulence in the channels. This not only reduces fouling during operation, but also makes subsequent chemical cleaning very effective.

- **ensure flexibility**
  Plate heat exchangers provide the flexibility to adjust capacity by simply adding or removing plates while maintaining the existing frame. This allows continuous optimization of the process parameters and is a major advantage in relation to the fixed capacity of shell-and-tube heat exchangers.



AlfaCond
The world's first tailor-made plate condenser, AlfaCond, was developed specifically for condensing vapours under low pressure/vacuum conditions in evaporation and distillation systems. The compact design makes it available to suit specific applications and capacity requirements. Features include semi-welded plates, large connections and unique channel spacing.

AlfaVap
The compact AlfaVap rising film evaporator is widely used within many applications. With its economic efficiency, the plate evaporator replaces conventional large and expensive shell and tube units. Features include semi-welded plates, large connections and wide channels.

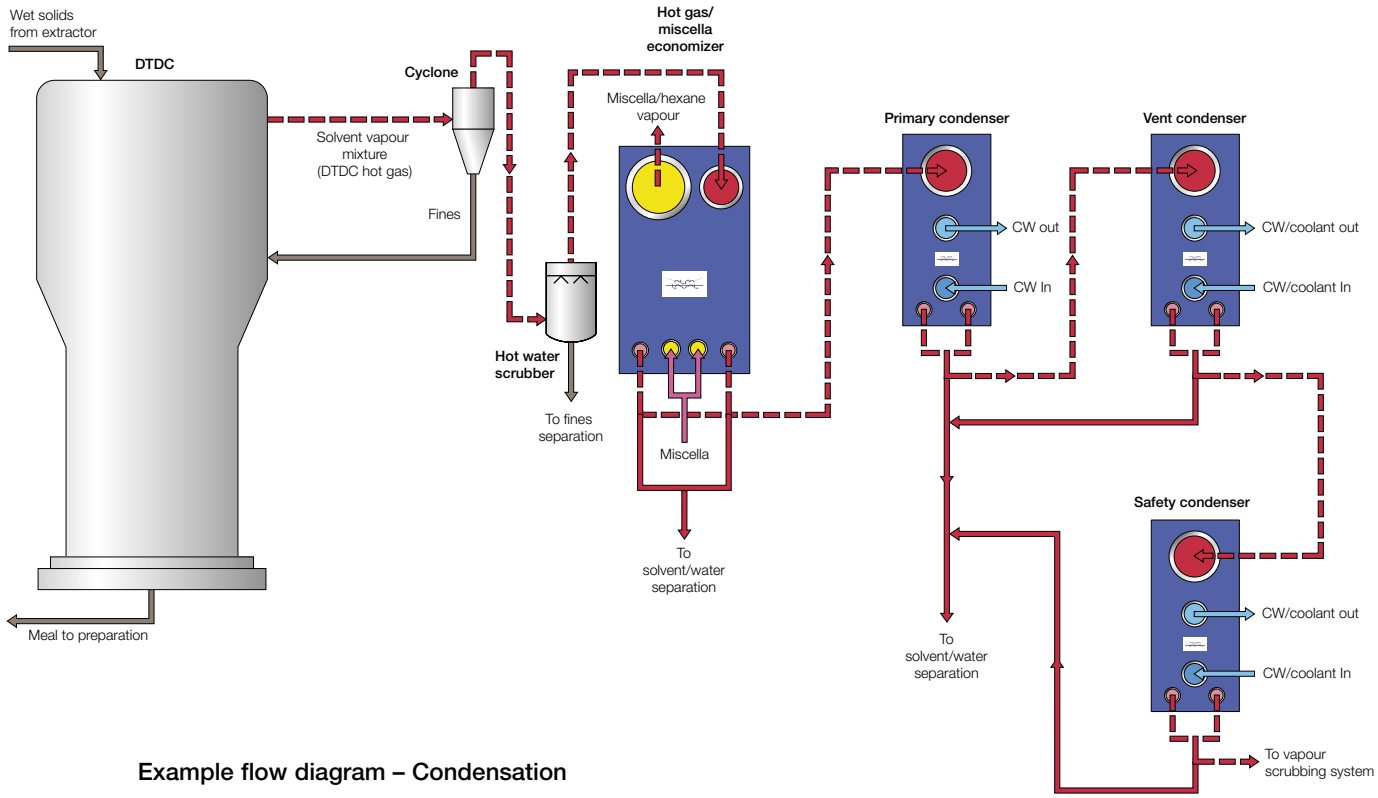
Compabloc®
This versatile welded plate heat exchanger can be used as a condenser, evaporator, re-boiler and liquid-to-liquid exchanger.

Spiral heat exchanger
These welded heat exchangers are ideal for condensation, reboiling and liquid-to-liquid duties, particularly at very low pressures and/or high volume flows.

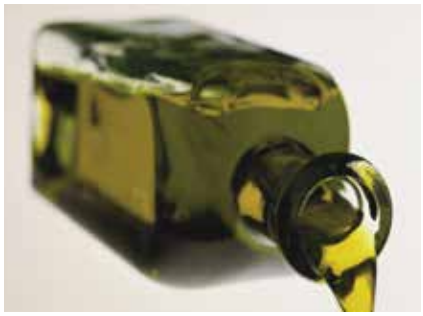
Semi-welded plate heat exchanger
A full range of semi-welded heat exchangers for varying capacities.

Environmental concerns
Government regulations constantly demand less solvent release into the atmosphere. Alfa Laval heat exchangers are the perfect way to comply with such regulations due to their unique design and very close temperature approaches.

Hot gas condensation



Example flow diagram – Condensation



Condensing DTDC hot gas

The solid material leaving the extractor, often wet flakes, is saturated with hexane. This hexane must be removed before the solids can be sold as meal or reused.

The removal process takes place in the DTDC, using vaporization with direct steam injection. The vapour mixture leaving the DTDC – the DTDC hot gas – consists of steam, hexane and small quantities of air, together with some fine material. The DTDC hot gas is used to regeneratively evaporate the miscella in the economizer, and is itself also condensed in this unit. The remaining vapour flow is handled in a series of condensers that comprise a

primary condenser, a vent condenser and, in some cases, a safety condenser.

Any non-condensables that remain after this circuit continue on to the vapour scrubbing system.

Use Alfa Laval technology to

- boost condensation
- reduce the load on the vapour
- scrubbing system
- replace corroded units

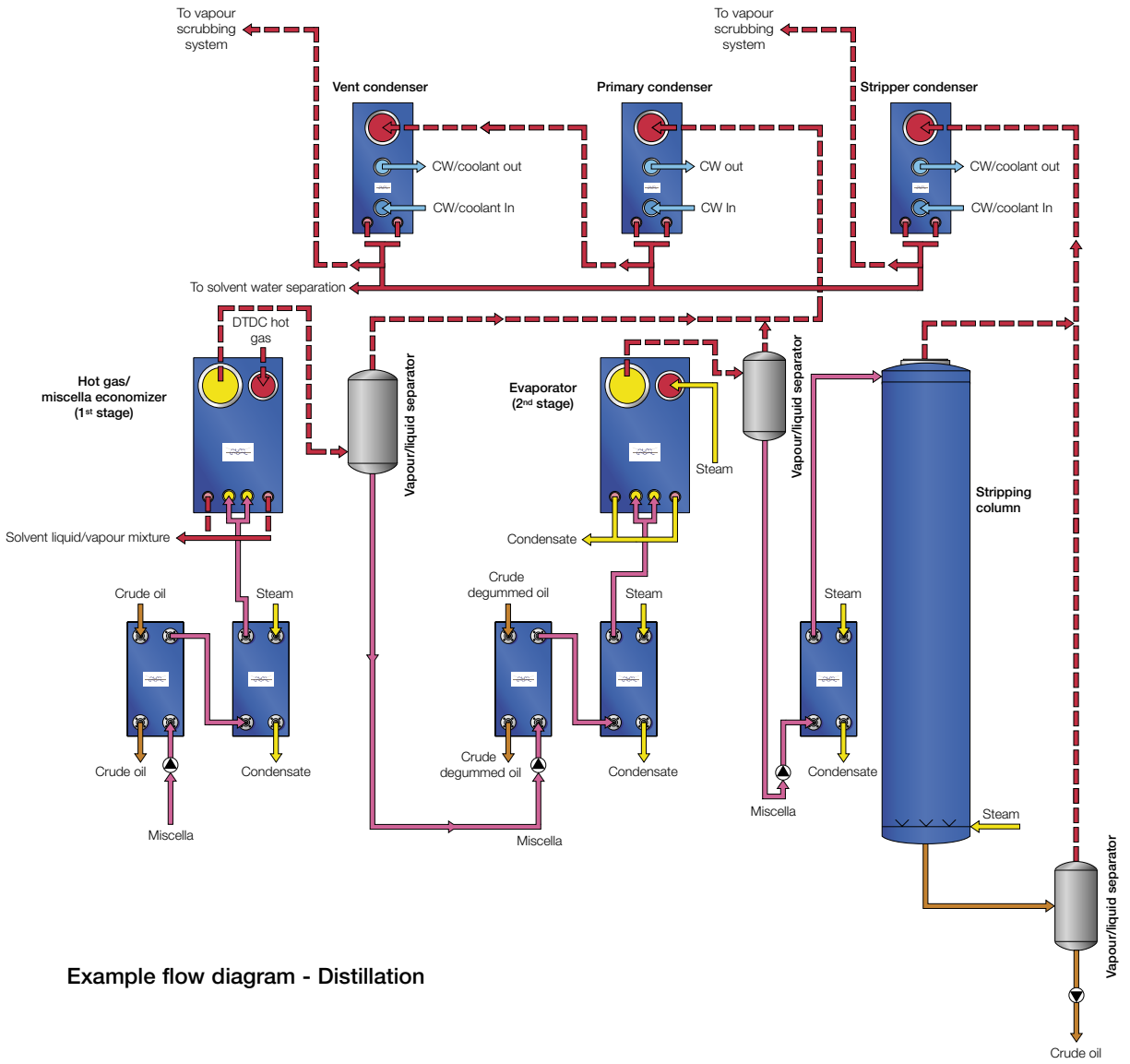
Growth at lower cost

Thanakorn Vegetable Oil Products Co. Ltd. has been producing edible oil products in Thailand since 1977. Specializing in soybean oil and rice bran oil, the company is recognized as the most progressive in its field.

Over the years, the Thanakorn extraction plant has increased its capacity by more than 250%. As part of this expansion, the company has installed more and more plate heat exchangers to replace and augment the original shell-and-tube units. Today, Alfa Laval equipment serves in a wide range of different installations as evaporators, condensers, economizers, chillers and reboilers.

The compactness and efficiency of Alfa Laval plate heat exchangers have played an important part in Thanakorn's expansion programme. As the Deputy Managing Director, Mr Sek Boonbunloo, notes, "Our main benefits ... are lower installation cost compared with the shell-and-tube units, higher heating exchange efficiency and smaller space requirements. This will support expansion of our production capacity without enlarging the building."

Miscella evaporation and distillation

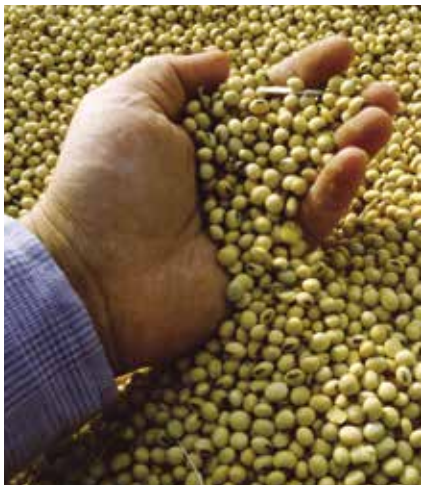


Example flow diagram - Distillation

Removing solvent from the miscella

The miscella leaving the extractor is concentrated in stages. First it is preheated and then regeneratively evaporated in the economizer using the DTDC hot gas as the heating source. The miscella then passes to the second-stage evaporator, which operates using steam. A steam stripping column extracts any remaining hexane and concentrates the oil to its final required level. Vaporized hexane gas from the evaporators and the stripping column must then be condensed.

Imcopa, Brazil



This is done in a primary condenser and then a vent condenser. Vapour that leaves the stripping column is treated in the stripper condenser, and non-condensables from both proceed to the vapour scrubbing system.

Use Alfa Laval technology to

- boost evaporation
- improve heat recovery
- boost condensation
- reduce the load on the stripping column
- reduce the load on the vapour scrubbing system
- replace corroded units

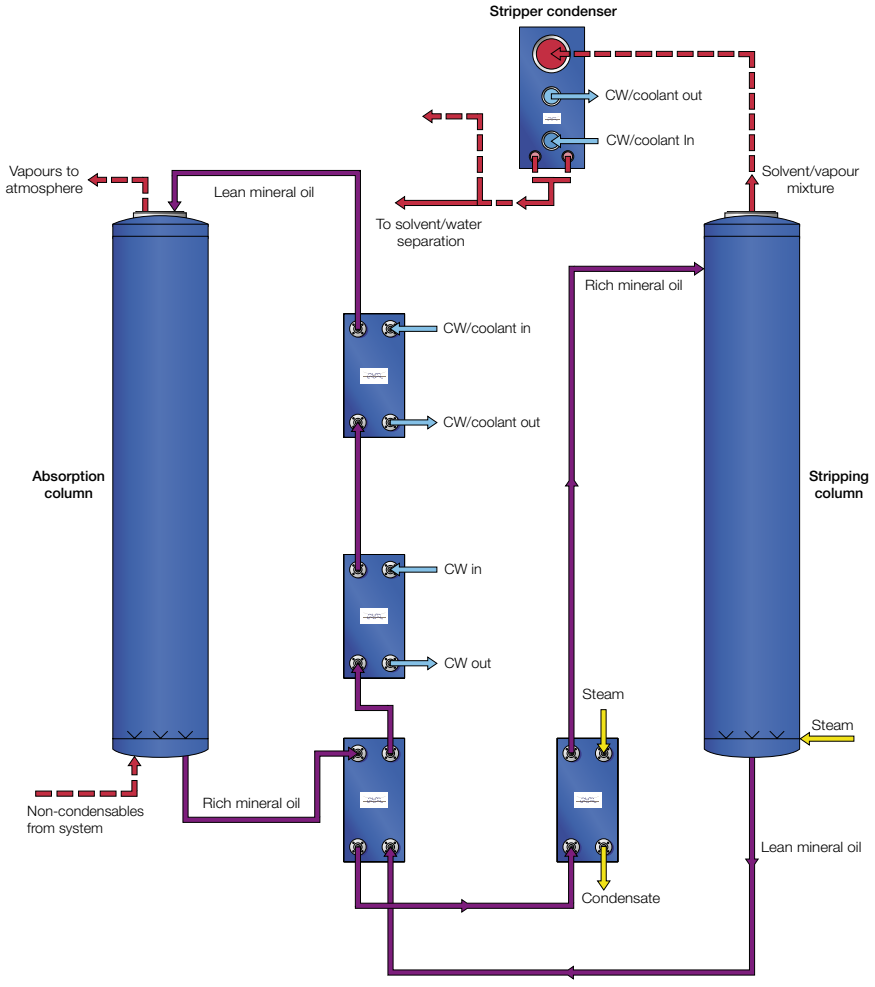
Solving the space problem

Caramuru Alimentos Ltda., a major Brazilian processor of soybeans, operates crushing plants in both São Simão and Itumbiara. Expansion of capacity at the company's São Simão plant meant that condensation processes could not keep up, and hexane solvent was therefore being passed to the vacuum system.

Better recovery was needed, but space considerations made a shell-and-tube installation impractical. Applying Alfa Laval know-how in evaporation and condensation technologies provided a solution with a semi-welded M20-MW plate heat exchanger installed in parallel with existing units.

Not only was the production bottleneck effectively removed, but the space-saving Alfa Laval solution also kept installation costs to a minimum.

Vapour scrubbing



Example flow diagram – Vapour scrubbing

Vapour scrubbing

The exhaust from the entire solvent recovery system is combined and sent to the vapour scrubbing system. This exhaust vapour is scrubbed to remove residual hexane, using mineral oil in an absorption column. Lean mineral oil is brought into contact with the hexane-rich vapour, which is then absorbed.

The rich mineral oil is then regeneratively heated by lean mineral oil once more in a steam heater, before entering a stripping column where the hexane is removed with steam.

This hexane is recovered by condensation. The lean mineral oil is then cooled, first regeneratively using the rich mineral oil and then normally in a series of two coolers, one using cooling water and the other a coolant.

Use Alfa Laval technology to

- increase mineral oil absorption capacity
- reduce hexane loss into the atmosphere
- anticipate and meet more demanding environmental regulations
- replace corroded units

Challenge us to show you the right combination

Alfa Laval heat exchangers can have a great impact on both new and existing solvent recovery systems.

They allow you to optimize existing plants now operating at greater capacity than they were designed for, as well as making it possible to expand your existing production line. This can be done with only a minimum of alterations to the installation and major equipment, and with limited capital investment.

Compact heat exchanger solutions also provide opportunities for making new plants smaller, lighter, more maintenance-friendly and more suitable for future expansion.

The Alfa Laval range of equipment for solvent recovery processes includes:

- AlfaCond, the world's first tailormade plate condenser
- AlfaVap, the tailor-made rising film evaporator
- Compabloc, the versatile welded plate heat exchanger
- Spiral heat exchanger, the welded spiral channel heat exchanger
- Semi-welded plate heat exchanger, the complete range for varying capacities

Solutions for more than just one solvent process

In addition to the typical seed oil extraction process shown here, Alfa Laval can help you with solvent recovery from other fats and oils processes such as solvent fractionation, extraction from fish meal, extraction of oil from spent bleaching earth and others.

Your solution provider for fats and oils processes

Alfa Laval is a leading supplier of equipment and processing technology to the fats and oils industries. We provide process knowledge in degumming, neutralization, bleaching, dry dewaxing, deodorization, deacidification, modification processes and more, while delivering such Alfa Laval equipment as our PX separators, MX mixers, the SoftColumn deodorization system and a full range of compact heat exchangers.

Alfa Laval in brief

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

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

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

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

How to contact Alfa Laval

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

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