



## Fertilize your own plant

How plate heat exchangers from Alfa Laval can transform the fertilizer industry





# In the fertilizer business, small changes

In a fertilizer plant like yours, it doesn't take much at all to increase both performance and peace of mind. That's usually what comes from less maintenance downtime, lower investment and installation costs, lower cooling-water consumption, considerable energy savings and lots of liberated floor space. The secret? Plate heat exchangers from Alfa Laval for heating and cooling processes along the production line.

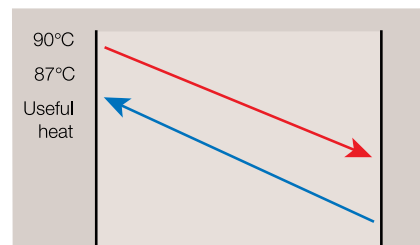
The most commonly used equipment for these tasks are shell-and-tube heat exchangers. Unfortunately, they are costly, bulky and inefficient. Plate heat exchangers, by contrast, are

exceptionally efficient. Despite a fraction of the footprint, they can recover more heat and save more energy than any shell-and-tube. And when they need cleaning, it takes hours rather than days – reducing downtime accordingly.

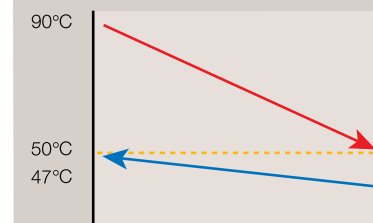
### Crossing temperatures save energy

There are many reasons why a heat exchanger from Alfa Laval is able to save and recover so much more energy than any shell-and-tube.

By definition, the temperature approach between the hot and cold sides in a plate heat exchanger can be much closer – down to a mere 2-3°C – because the flows are fully counter-



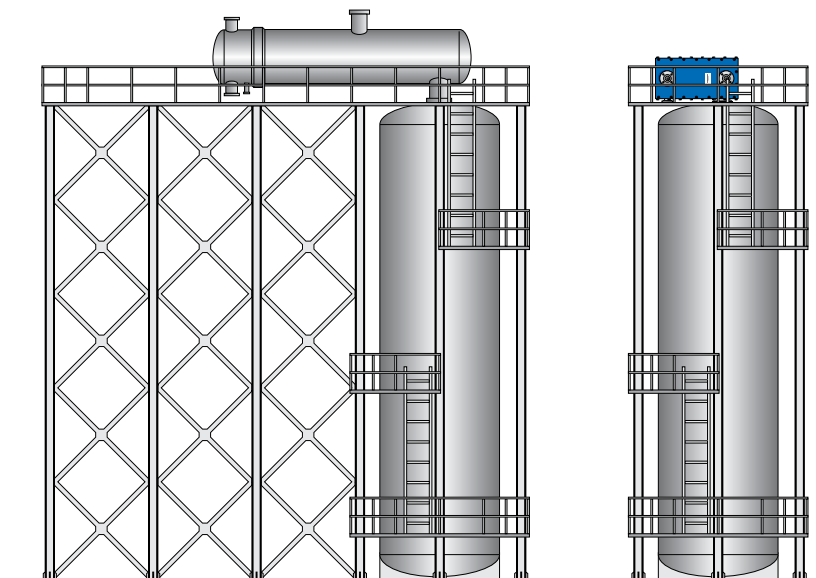
A compact heat exchanger is able to recover virtually all of the incoming heat (above). With a shell-and-tube, this is not possible – by design (below).



current, allowing the temperatures of the two sides to cross.

As a result, excess heat emerging from one process can be captured and used in another – much more effectively and economically than with shell-and-tube technology. The crossing temperatures can also create a subcooling effect that reduces the need for costly artificial cooling or compressor power.

Not only does a plate heat exchanger save considerable floor space compared to a shell-and-tube. In many cases installation is greatly simplified, with no need for cumbersome and costly foundations.





# can make big differences

## More for less

The overall heat-transfer coefficient of plate heat exchangers is up to five times higher compared to shell-and-tube heat exchangers. Or put differently: the heat-transfer area needed is smaller. This normally makes Alfa Laval plate heat exchangers less costly than shell-and-tubes.

It also shrinks their dimensions and footprints to a fraction of shell-and-tubes with comparable performance. Valuable floor space can be freed up and used for expansion. The compact sizes and low weights also make installation simpler and less costly, thanks to smaller foundations.

## Avoid summer capacity drops

Plate heat exchangers can cool the process media to a mere 2-3°C above the cooling water temperature. If warm



A major European chemical company was experiencing severe capacity drops during summertime operation. By installing Compabloc heat exchangers to replace shell-and-tubes, they not only resolved the bottleneck but also addressed corrosion problems through the material upgrade with only a fraction of the heat-transfer area and space. The Compablocs use about half the floor space of the equipment they replaced – while providing 50% more capacity.

cooling water during summer time operation is creating production bottlenecks, plate heat exchanger technology can therefore be an economical solution.

## Less cooling water

The efficient, fully counter-current plate heat exchangers often make it possible to save considerable volumes of cooling water needed in some process steps. So wherever the flow of cooling water is an issue causing operators a headache, plate heat exchangers could be their best pain killer.



# Killing a few myths about plate heat

In the production of nitrogen fertilizers, common wisdom prescribes shell-and-tube technology for the many heat-transfer duties along the line. And because production stops can be quite disastrous, many people in the fertilizer industry stick with what they know, rather than introducing solutions new to them. Better safe than sorry.

Consequently, plate heat exchangers are rumored to be sensitive, unreliable and heavy on maintenance.

Maybe it's time to dissect some of the myths that these rumors are founded on.

**Myth 1:**  
**Plate heat exchangers can't handle fouling media**

With process and cooling liquids containing particles and debris, how can the narrow channels of plate heat exchangers avoid becoming clogged?

The answer is twofold. Larger debris such as gravel can easily be separated in a filter preceding the heat exchanger. Sedimentation of smaller particles can be avoided through best-practice heat exchanger design.

By combining the right degree of turbulence with the right heat-transfer area, the plate heat exchanger can be optimized against fouling propensity.

HTRI study of typical fouling in cooling-tower water

	PHE	S & T
Flow velocity (m/s)	0.45	1.8 m/s
Shear stress	ca 60	ca 15

Result: fouling in the PHE was 50-70% lower

It is actually a proven fact that plate heat exchangers show a lower fouling tendency than shell-and-tube heat exchangers. This is why many Alfa Laval heat exchangers are successfully operated in process-critical positions using river or seawater as direct cooling media.

**Myth 2:**  
**Gaskets are not reliable**

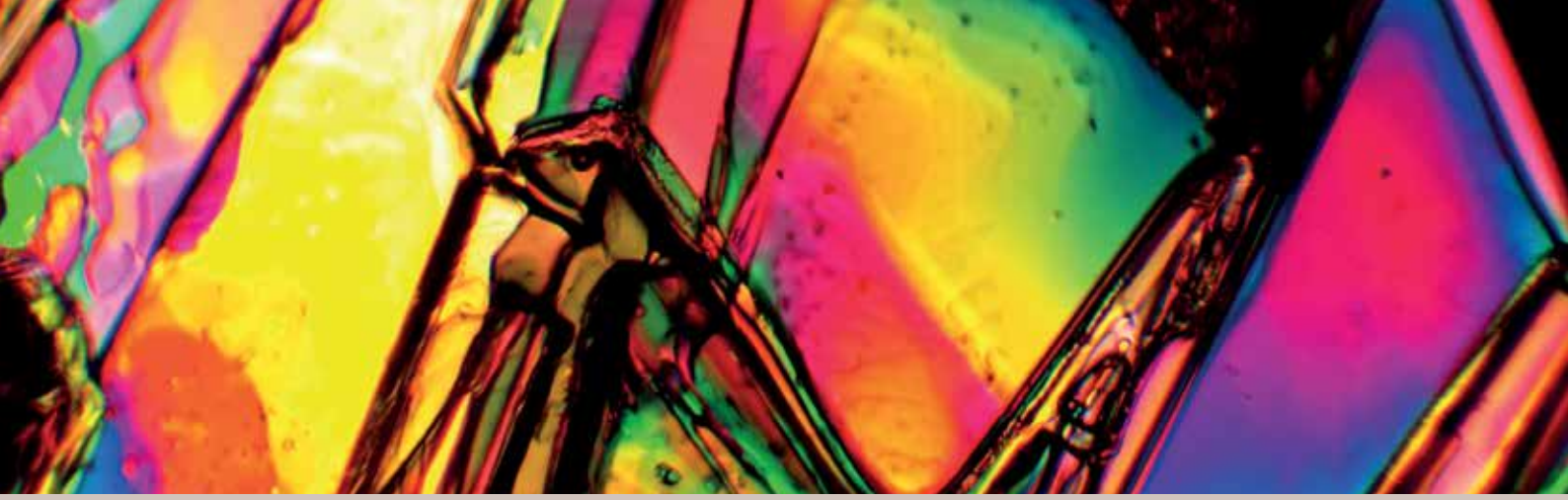
Are gasketed plate heat exchangers likely to leak?

No. Over the past several decades, Alfa Laval has successfully installed thousands of semi-welded and gasketed heat exchangers for use with  $\text{NH}_3$  and other aggressive chemicals.

The key to long-lasting gaskets is, first of all, to select the right type for each job. The reliability and service life of the gaskets can be extended considerably through good gasket design and



To increase production capacity, DneproAZOT, a Ukrainian fertilizer plant, replaced two shell-and-tube gas coolers with a single fully welded Alfa Laval Compabloc. The gas can now be cooled down to 35°C, even in summer, using water from the nearby Dnieper river. This has resulted in increased urea production and lower compressor power consumption.



# exchangers



In 2003, AB Achema in Lithuania replaced its NOx gas coolers/condensers. With only 193 sqm of heat-transfer area, the Compabloc achieves the same capacity as two shell-and-tubes with a total heat-transfer area of 950 sqm.



quality materials. There is an optimal combination of materials, shapes and glues for dealing with every combination of temperature, concentration and pressure of the aggressive liquid – without leaking.

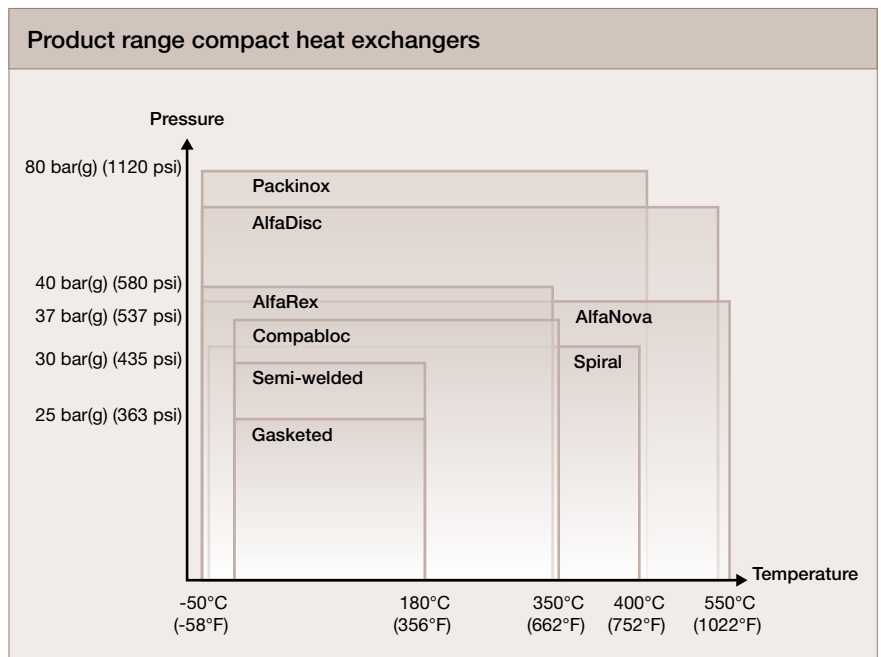
And when things get too demanding even for this – for reasons of temperature, pressure or chemistry – welded plate heat exchangers are the obvious alternative.

**Myth 3:**  
**Plate heat exchangers are only suited for low-pressure liquid/liquid heat transfer**

Many fertilizer producers are familiar with plate heat exchanger technology for simple water-to-water utility duties. This could be why they presume that plate technology is unsuitable for other purposes.

They are mistaken. Today, Alfa Laval offers a full portfolio of specialized plate heat exchangers used as

condensers, evaporators, reboilers, partial condensers and vacuum steam condensers. More than 10,000 gasket-free Alfa Laval heat exchangers are currently in operation in a variety of process duties where gaskets can't be used.





# The plants that tried will never be the

Far from all fertilizer plants are saying no to progress. Over the past few years, more than fifty of them, active in every major fertilizer process, have started to replace shell-and-tube heaters, coolers, condensers, evaporators or reboilers in mission-critical process positions with plate heat exchangers from Alfa Laval. These are some real-world examples:

## **Ammonia**

One ammonia plant in North Africa is saving capital costs and floor space by installing semi-welded plate heat exchangers as ammonia condensers. Through increased subcooling of the ammonia, it is also saving large amounts of energy in the refrigeration section of the plant.

An ammonia/urea plant in Malaysia uses Alfa Laval Compabloc heat exchangers in its CO<sub>2</sub> removal system – reducing capital investment costs and recovering more than 5 MW of energy.



## **Urea**

A urea plant in China chose AlfaCond condensers as energy-efficient vacuum-steam condensers in the urea evaporation section. The limited plant space available for this upgrade was no problem for the compact plate technology. A shell-and-tube solution would not only be less efficient – it would simply be too big.

Another urea plant in Ukraine switched to Compabloc heat exchangers to serve as hydrolizer interchanger and reboiler in the waste-water treatment system. Result: less than a year's pay-back time thanks to steam savings in the reboiler.

## **Nitric acid**

A nitric-acid plant in the Baltics is using Compabloc heat exchangers as NO<sub>x</sub> gas coolers. Cost and space savings compared to the earlier shell-and-tubes are impressive.

Another nitric-acid plant in Colombia uses eleven Compabloc heat exchangers for acid cooling. The Compablocs also solved the severe corrosion and fouling problems experienced earlier with shell-and-tube exchangers.

## **Ammonium nitrate**

One ammonium-nitrate plant in Japan replaced a conventional shell-and-tube solution with plate heat exchangers in its evaporation system for concentrating the ammonium nitrate. The savings in terms of costs, space and energy are substantial.

Another plant in Slovakia is recovering considerable amounts of heat by using Alfa Laval Compabloc heat exchangers. Thanks to the high thermal efficiency of these units, the 95% ammonium nitrate can now preheat the 80% ammonium nitrate – reducing the need for costly external heat.



same. Fortunately



When the Syzran refinery in Russia extended its plant in 2002, Alfa Laval plate heat exchangers were installed as reboilers and condensers in the amine-absorption stripping system. The Compablocs are successfully used as reboilers for the 15% MEA solution, while the column-mounted reflux condenser is cooling/condensing the vapour mixture from 115°C to 40°C.

Product facts	
<p><b>Compabloc</b> Gasket-free plate heat exchanger for applications where gaskets are not an option. The only welded plate heat exchanger with full accessibility to both sides. A good fit for any position in CO<sub>2</sub> removal systems, as well as NO<sub>x</sub> gas cooler/condenser in nitric-acid plants and many other positions.</p>	
<p><b>AlfaCond</b> Specialized vacuum-steam condenser commonly used in conjunction with steam turbines and evaporation systems. A good condenser for most vacuum-condensing applications.</p>	
<p><b>AlfaVap</b> Specialized evaporator for ammonium-nitrate evaporation. Also suitable as reboiler in amine or potassium carbonate-based CO<sub>2</sub> removal systems, where low-grade steam can be used as heating media.</p>	
<p><b>Gasketed and semi-welded plate heat exchangers</b> A multitude of versions, sizes and materials – adapted to a wide variety of heating and cooling duties.</p>	
<p><b>AlfaDisc</b> Fully welded plate heat exchanger for heat recovery at medium pressures. A good fit for heat recovery from high-pressure condensate in ammonia plants.</p>	
<p><b>Decanter centrifuge</b> Used in nitro-phosphoric acid plants for silica removal. Also suitable for soot removal from quench water in coal-based ammonia production.</p>	
<p><b>High-speed separator</b> For compressor lube oil treatment.</p>	
<p><b>Back-flushing ALF filters</b> For automatic separation of larger debris and particles from the flow prior to entering plate heat exchangers. Also ideal for sifting seawater before sending it into cooling-water coolers.</p>	



# Fertilize your ammonia plant

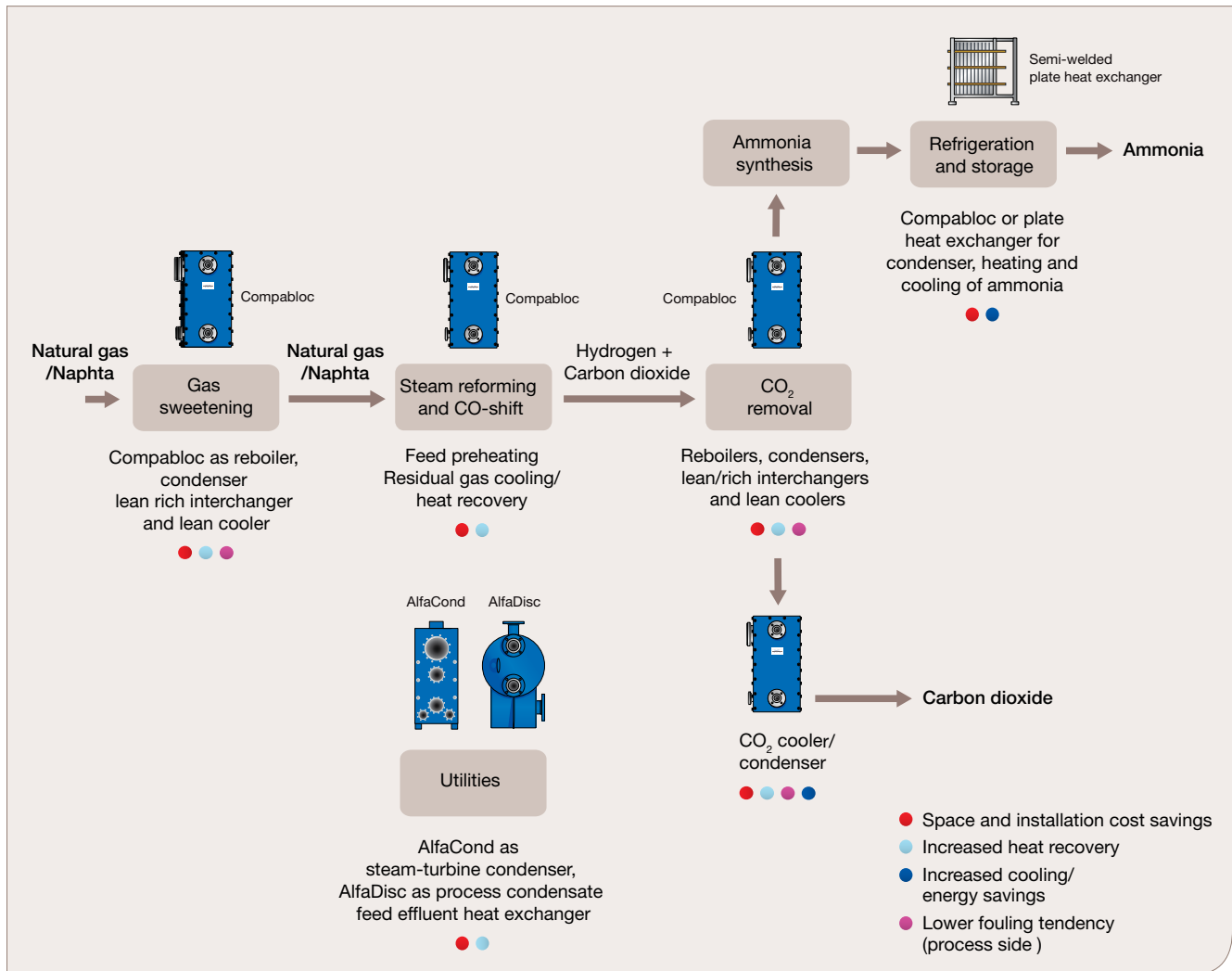


Plate heat exchangers – whether gasketed or welded – are the most efficient technology for heat transfer known to man. Thanks to the fully counter-current flow, it is possible, for example, to cool CO<sub>2</sub> gas containing water to a temperature very close to the

cooling water temperature. This saves power in subsequent CO<sub>2</sub> compressors. Due to the high efficiency – two to five times higher than shell-and-tubes – summertime capacity drops in ammonia condensers can be avoided with a low incremental investment.

In the CO<sub>2</sub> removal section, plate technology can be used for all heat-exchanger positions. It offers especially strong benefits in the lean/rich interchanger, where it is possible to achieve considerably higher levels of heat recovery.





# Fertilize your urea plant

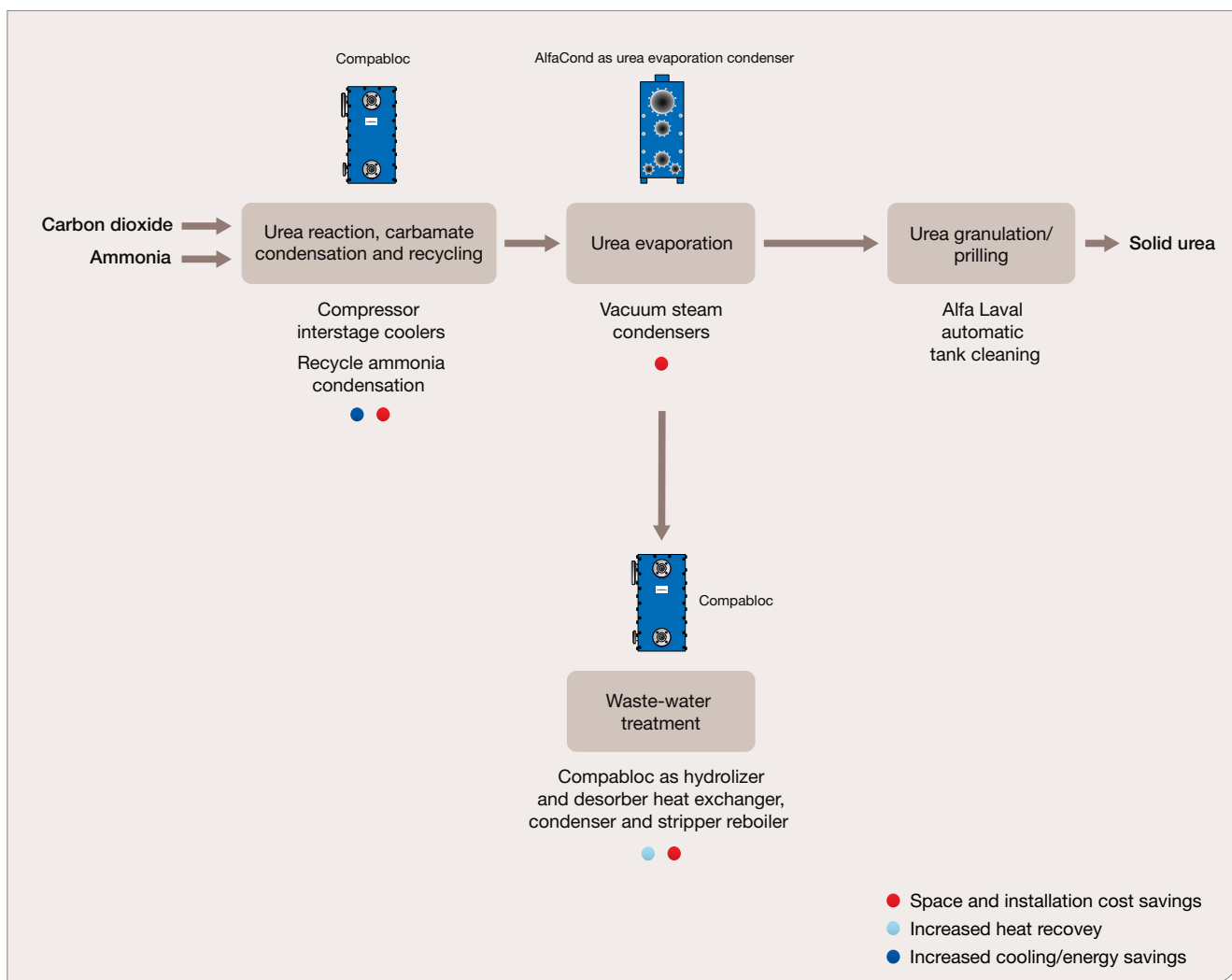


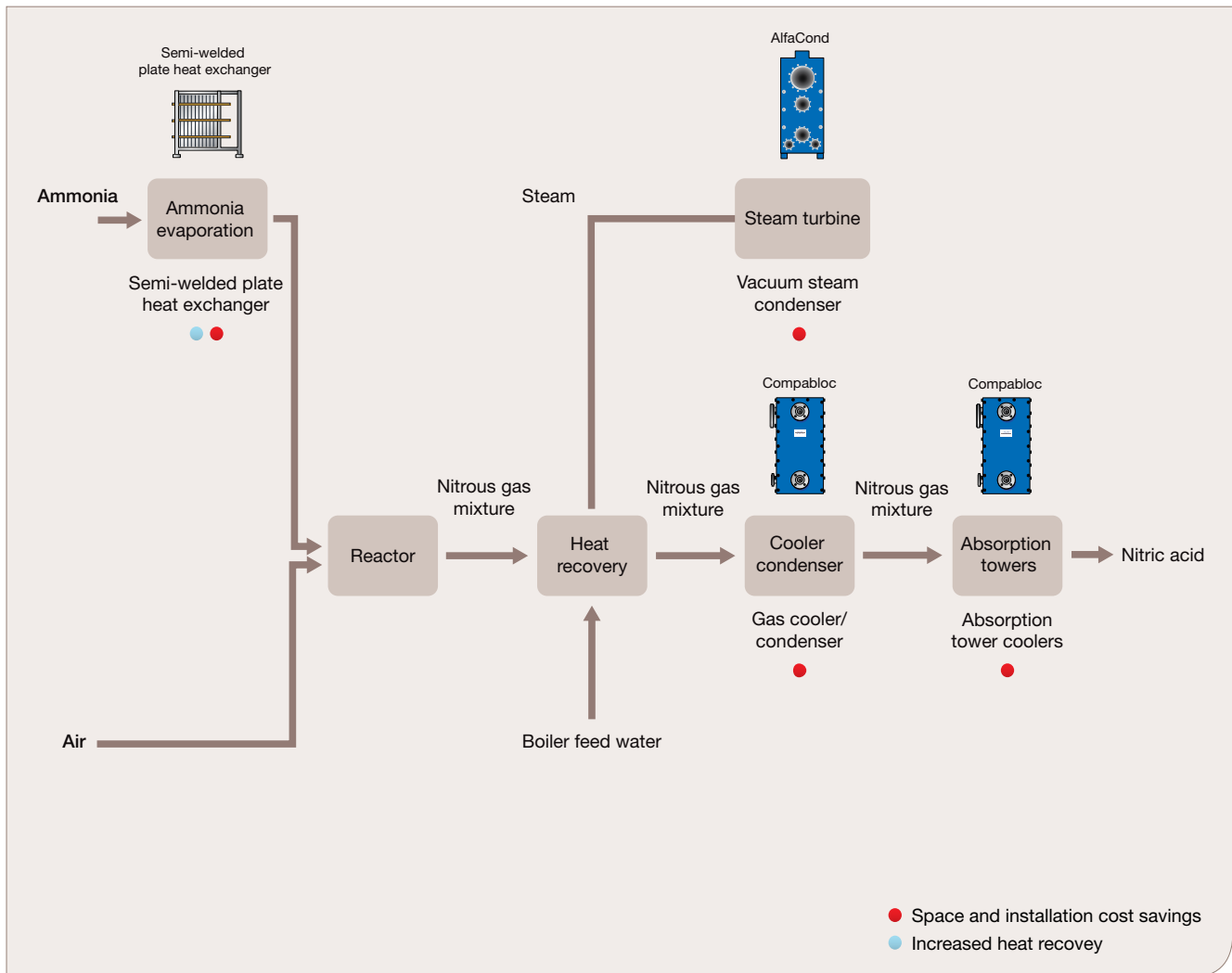
Plate heat exchangers can reduce your total installation cost, not only through lower equipment cost, but also by reducing the cost of support structures surrounding the heat exchanger.

AlfaCond condensers are much more compact, weigh less and offer up to 400% higher heat-transfer efficiency, compared with shell-and-tubes. They are therefore ideal as urea evaporation-system condensers.

Using welded Compabloc heat exchangers as a hydrolizer interchanger in the waste-water treatment plant will slash your heat-exchanger cost, while reducing steam consumption in the hydrolizer tower.



# Fertilize your nitric-acid plant

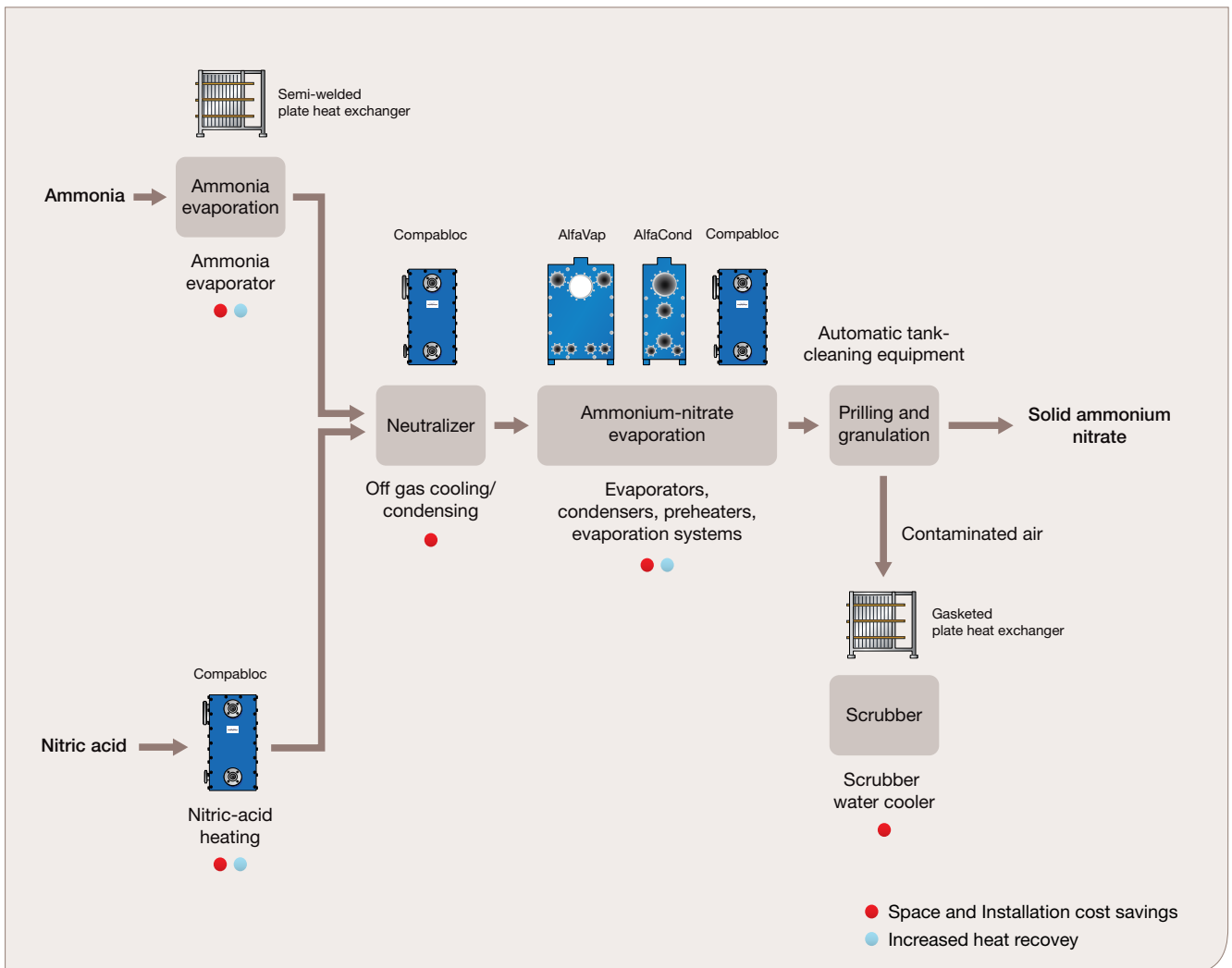


NOx-gas cooling and condensing are difficult and corrosive heat-transfer duties. Compabloc heat exchangers have proven to fit the bill perfectly – often with less than a quarter of the space requirements of shell-and-tubes. Compablocs can also be used for cool-

ing nitric-acid absorption towers. Here, the superior heat-transfer efficiency quickly translates to lower cost and smaller footprint.



# Fertilize your ammonium-nitrate plant



In ammonium-nitrate production, it is possible to cut capital costs considerably by using plate heat exchangers. In corrosive duties like evaporator preheaters or nitric-acid preheaters, plate heat exchangers save both energy and investment costs.

In fact, the evaporators, too, can be replaced with AlfaVap evaporators, if the boiling temperature allows for gaskets to be used.

## **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)