



Boost your refinery benefits

All-welded plate-type heat exchanger solutions





In refinery operations, all-welded plate-type heat exchangers are the most cost-effective way to conserve energy and reduce emissions. This can result in major reductions in the environmental impact of the many processes used in oil refineries.

All-welded plate-type heat exchanger designs from Alfa Laval are easy to integrate into demanding refinery environments. They have a proven record of boosting processing efficiency and product value, as well as reducing installation and operating costs.

Refined solutions

Applied technology accelerates achievement

Energy conservation – the key to cutting costs

Energy is essential for many refinery operations and can account for as much as 50% of total operating costs. This energy is not only expensive – its production also has a vast environmental impact.

Soaring energy costs and global environmental concerns about emissions of greenhouse gases, along with the highly competitive market for refinery feedstocks and products, all put constant pressure on refineries to operate more efficiently and more economically.

Recovering thermal energy that has already been used once and then using it again therefore plays a key role in optimizing refinery operations.

And energy recovery is also one of the few major upgrade measures that provides a rapid return on investment.

Making processes run more efficiently

The all-welded plate-type heat exchanger technologies pioneered by Alfa Laval can exploit energy inputs much more effectively than traditional solutions in association with superior hydraulic characteristics.

Alfa Laval Packinox exchangers, for example, provide opportunities for more effective heat recovery with a lower pressure drop. Because the reaction loop is at lower pressure, the catalytic reforming process can operate at a higher production rate. This means better reaction efficiency, improved yield and increased hydrogen production.



Global supplier

Alfa Laval is the world leader in supplying the all-welded plate-type heat exchangers used in countless oil refining processes, and the only global provider of such solutions. Almost a thousand heat exchangers of this type are already installed throughout the world to help optimize a wide range of processes in oil refineries.



Keen to cut down on energy and emissions?

Energy-efficient heat exchanger solutions

Excellence in heat recovery

Different types of Alfa Laval all-welded plate-type heat exchangers extract and re-use energy with unparalleled efficiency. This significantly reduces both fuel costs and the life cycle costs of refinery process units.

All-welded plate-type heat exchangers are therefore rapidly becoming standard equipment in many refinery processes and installations, replacing traditional technologies such as bulky shell-and-tube units and energy-wasting air coolers. They provide numerous significant end-user benefits that include

- greater production throughput
- energy conservation via heat recovery
- reduced emissions
- lower CAPEX and OPEX
- less downtime and reduced maintenance
- improved operating costs.

Reducing processing costs

Oil refineries are capital-intensive installations with high operating costs. And because heating and cooling are important parts of most refining operations, energy costs are normally the largest single expense in a refinery's operating budget.

Advanced plate heat exchanger technology therefore makes it possible to make dramatic improvements in the basic cost parameters. Even small improvements in heat exchanger performance mean considerable savings that add up to new milestones in cost-effectiveness.

Cutting back on emissions with efficient heat transfer

Thermal NO_x

- Amount produced is primarily a function of flame temperature
- Estimated reduction in emissions: 3 tons per process MW per year

Fuel NO_x

- Amount produced depends on nitrogen content in the specific fuel (N% wt.)
- Emission = 36*N tons per process MW per year
- Estimated reduction in emissions: N = 0.25% = 9 tons per process MW per year

Total NO_x = thermal NO_x + fuel NO_x

- Estimated reduction in emissions = 12 tons per process MW per year
- Monetary value = USD 1,000 per ton = USD 12,000 per MW per year

SO_x

- Functions of sulphur in heater fuel (S% wt.)
- Emission = 27*S tons per process MW per year
- Estimated reduction in emissions: S = 0.6% = 16 tons per process MW per year
- Monetary value = USD 1,000 per ton = USD 16,000 per MW per year

Greenhouse gases

- Carbon in fuel transformed into CO₂ during combustion
- Average carbon content in fuel: 71% by weight
- Emissions = 2,500 tons per process MW per year
- Monetary value = USD 20 per ton = USD 50,000 per MW per year

Summary

Monetary value (per year) of 1 MW duty gain using plate-type heat exchanger

- | | |
|---|-------------|
| • Fuel cost savings | USD 462,000 |
| • Reductions in NO _x and SO _x emissions | USD 28,000 |
| • Reductions in greenhouse gas emissions | USD 50,000 |

Assumptions

- USD 50 per BOE local fuel cost
- 65% heater efficiency
- 0.6% sulphur in fuel
- 0.25% nitrogen in fuel

Recovering energy in atmospheric distillation

Two Compabloc heat exchangers are installed in a refinery in the UK for cooling atmospheric residue using boiler feed water to ensure that the heat is recovered into the refinery's steam generation system.

The Compablocs have been in operation for three years with no need for service, and are now included in the refinery's 10-year maintenance scheme.



Lower capital and installation costs

The compactness of Alfa Laval plate-type heat exchangers means they are significantly cheaper to install. They take up much less space and require fewer alterations to buildings and other structures, as well as less extensive foundations and infrastructure.

Small size also means that it is relatively inexpensive to specify exotic metals for use in corrosive operating environments.

Lower energy costs

The thermal efficiency of Alfa Laval all-welded plate-type heat exchangers makes them models of good practice in energy conservation. This cuts down on energy costs, which are an increasingly important part of overall operating costs.

Lower maintenance costs

Because of their much greater reliability, Alfa Laval all-welded plate-type heat exchangers require less service and maintenance, with a significant impact on costs.

Alfa Laval heat exchangers are much more easily accessible for any service and maintenance that might be required. They are also easy to clean with standard CIP procedures, high-pressure cleaning equipment or using patented decoking by controlled combustion.

Lower emissions costs

More efficient heat transfer means that Alfa Laval all-welded plate-type heat exchangers make an important contribution to reducing the use of fossil fuels, thus cutting back on CO₂, SO_x and NO_x emissions.



Interested in getting processes to run more efficiently?

Performance improvements via advanced heat transfer

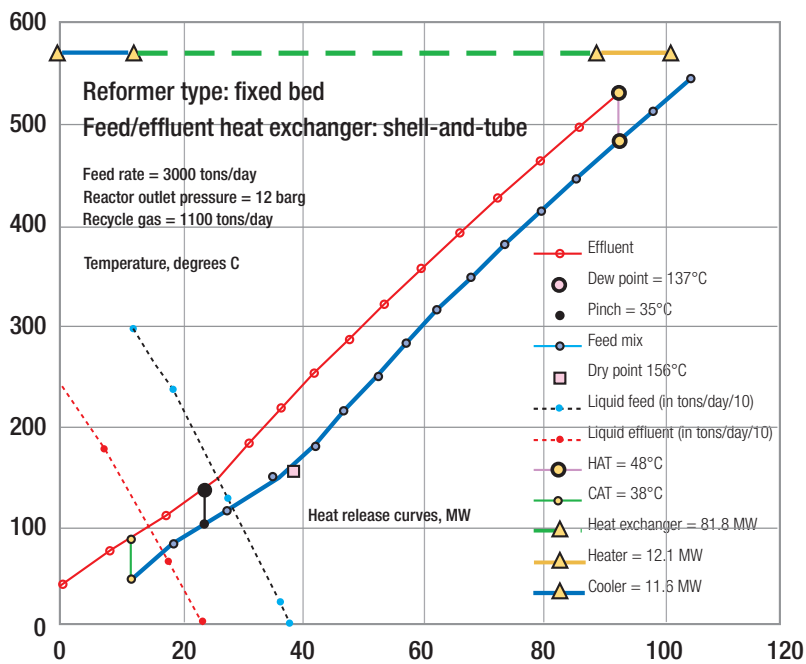


Figure 1 Catalytic reformer, using shell-and-tube

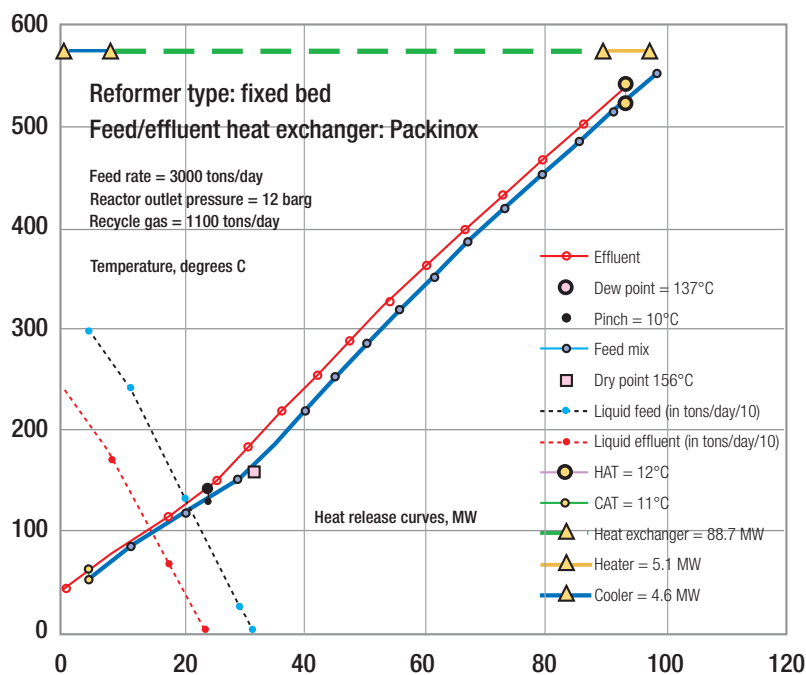


Figure 2 Catalytic reformer, using Packinox

The efficiency with which a heat exchanger extracts thermal energy from one medium and passes it on to another can result in important savings as well as significant improvements in how specific refining processes are undertaken.

Exceptional heat recovery

Design and process engineers focus increasingly on small pinch, temperature cross and the exploitation of even the tiniest temperature differences. When it comes to thermal performance, Alfa Laval technology is 2–4 times more efficient than any comparable shell-and-tube unit, even under difficult process conditions. Alfa Laval all-welded plate-type heat exchangers can exploit temperature differences as small as 3°C, and provide maximum benefit from pinch techniques.

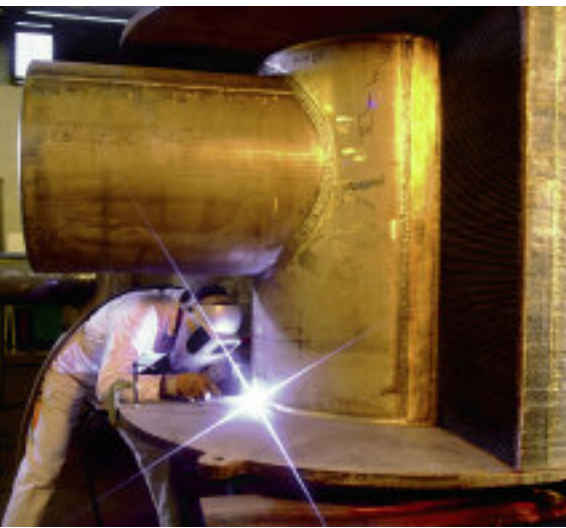
As an example, Alfa Laval Packinox feed/effluent heat exchangers reduce charge heater duties by achieving much closer pinch temperatures than is possible with traditional tubular types of heat exchangers. As the heat release curves show, this also means lower hot and cold approach temperatures (HAT and CAT). The inlet temperature of the charge heater is higher and its heat duty is lower, so less fuel is burned.



Catalytic reforming revamp

Shell installed one of the very first Alfa Laval Packinox heat exchangers in the catalytic reforming unit at its Berre refinery in France to deal with problems with low heat recovery and high pressure drop. These problems were largely solved by replacing 12 bulky horizontal shell-and-tube units, which not only improved performance and increased naphtha throughput by 33%, but also reduced energy consumption.

At the same time, the small footprint of the Packinox solution meant this major revamp was possible despite space restrictions, while weight reductions enabled Shell to achieve significant savings on installation costs.



Process optimization

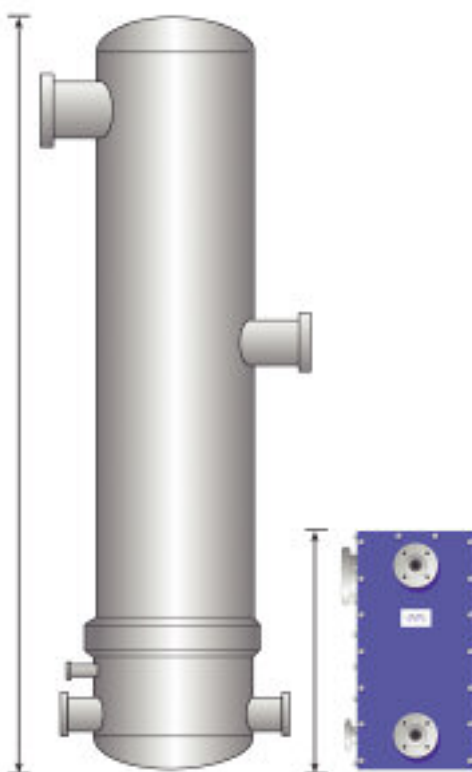
Refineries can achieve substantial boosts in processing efficiency using all-welded plate-type heat exchangers.

Installing a Packinox unit in the catalytic reformer results in lower pressure drop and better heat transfer performance. This makes it possible to ramp up production by as much as 40% with no other changes.

The thermal efficiency of Compabloc units guarantees higher energy conservation. As a result, more heat can be recovered into the boiler feed water system or the crude oil pre-heat train, as just two examples.



Spiral heat exchangers are ideal for extracting maximum heat energy from bottom residues, and their resistance to fouling ensures less downtime for cleaning.



Saving energy counts

To boost the reliability of its production, Shell replaced the shell-and-tube condensers at its Sarnia refinery in Canada with Alfa Laval Compabloc condensers. These units have now been in continuous operation ever since commissioning in 2002.

The main motivation was to save energy. Compabloc condensers provided the only feasible solution for using advanced alloys to avoid corrosion and to achieve the degree of heat recovery Shell was looking for.

Quantum leap

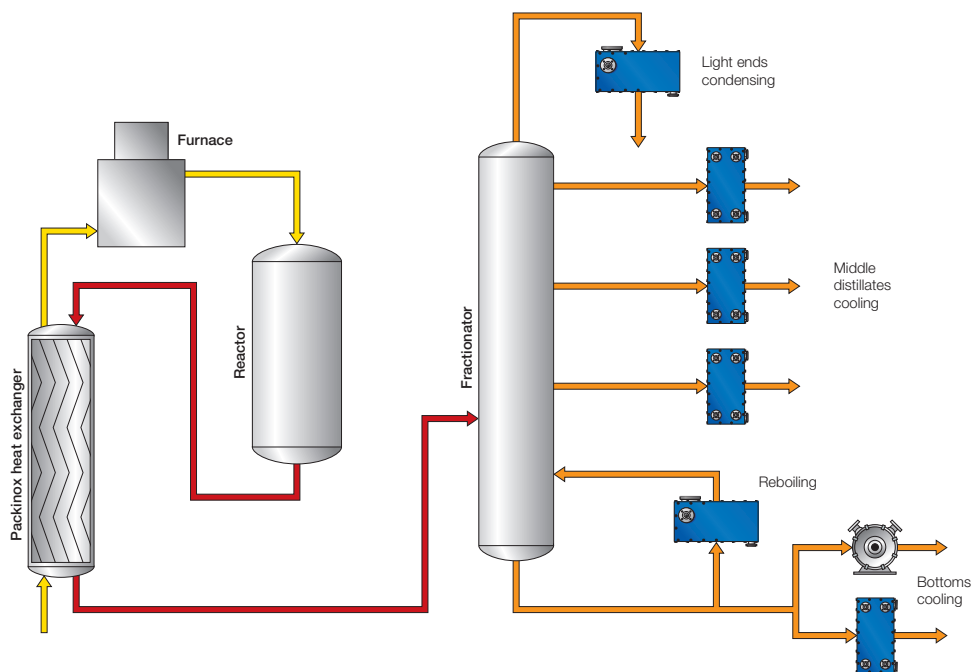
Alfa Laval all-welded plate-type heat exchanger solutions pave the way for big improvements

In refining operations, one of the keys to success and profitability is to move beyond mere incremental improvements to ensure a significant competitive edge. All-welded plate-type heat exchangers from Alfa Laval provide groundbreaking new levels of performance, reliability and profitability.

Packinox heat exchangers are normally used as feed/effluent exchangers in catalytic reforming units, and also in HDT and HDS units.

Compabloc heat exchangers are normally used as heaters, coolers, condensers and reboilers in virtually all the process units in the refinery.

Spiral heat exchangers are normally used to cool fouling bottom fractions as well as in top condensers where extremely low pressure drops are required, such as the vacuum tower.



The best all-welded heat exchanger technology in the right place.

Atmospheric and vacuum crude units

Compabloc units are often installed in the crude oil pre-heat train to pre-heat the undesalted and desalted crude oil using fractions from the distillation column, including overhead vapour, gas oil, atmospheric residue, etc.

Spiral heat exchanger units are normally used as the main condenser in the vacuum column.



Compabloc in operation since 1996 at a refinery in Sweden for condensing vapour after the vacuum tower. When condensed to below the dew point for water, the vapour becomes corrosive, and the Compabloc is therefore made of titanium.



Solving the cleaning problem

Severe fouling problems were experienced in 12 large shell-and-tube heat exchangers used for cooling the residue in the visbreaker unit at a major European refinery. Due to coke formation, these units had to be opened up to six times per year for cleaning, at great cost.

The units were therefore replaced by 8 Alfa Laval spiral heat exchangers that can be operated continuously with no unscheduled stops. These only need cleaning during the planned general shutdowns of the visbreaker unit, which takes place every five years.

Catalytic and thermal conversion processes

These include fluid catalytic cracking (FCC), hydrocracking, continuous catalytic reforming, isomerization, HDT, HDS, alkylation, cokers and visbreakers, lube oil and asphalt plants.

Packinox heat exchangers are often used as reactors and stripper feed/effluent interchangers in catalytic reforming, HDT and HDS installations.

Compabloc units are often used in all these process installations in conjunction with the fractionation stages, as condensers, coolers, pump-around coolers, feed/effluent interchangers and reboilers.

In lube oil and asphalt plants, Compablocs are used in conjunction with extract and raffinate duties as well as for pre-heating vacuum residue and cooling bitumen.

Spiral heat exchanger units are often used for cooling fouling residues such as FCC bottoms and visbroken residue.

Treatment processes

These include amine plants, sulphur recovery units (SRU), tail gas treatment (TGT), sour water strippers (SWS) and desalter plants.

Compabloc heat exchangers are often used as condensers, reboilers, interchangers and final coolers in amine, SRU, TGT and SWS plants. In TGT plants, Compablocs are also used for quench water cooling.

In desalter plants, Compabloc units are used as desalted water/feed water interchangers as well as for the final cooling of the desalted water.



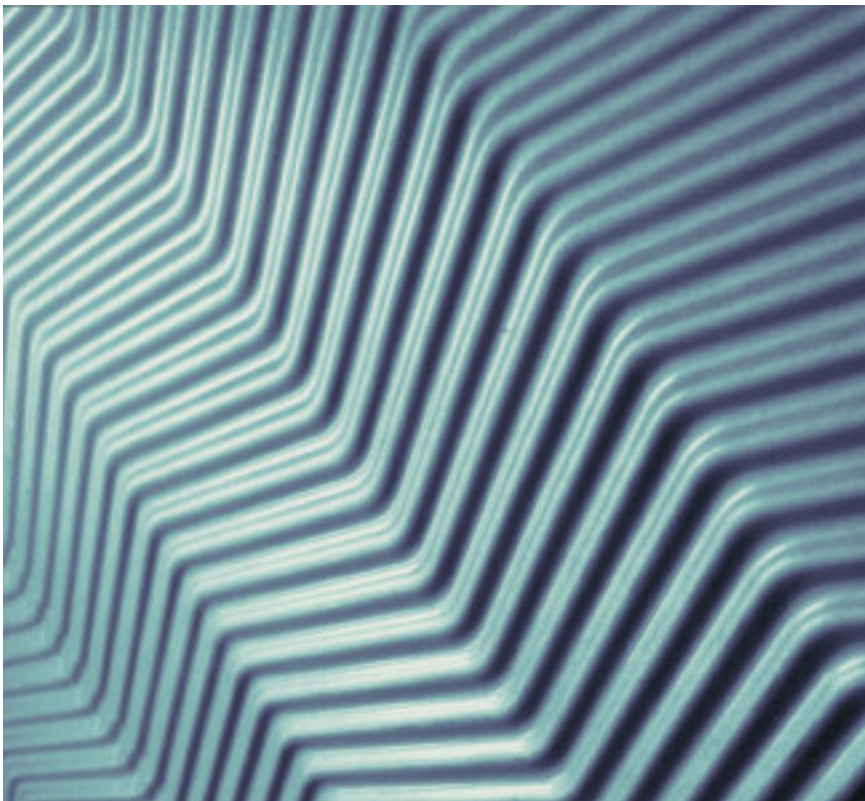
One instead of twelve

A combined feed/effluent heat exchanger is used in a refinery in the Middle East. The refinery aimed to increase the capacity of its catalytic reforming process by 50%. This was achieved using a single Packinox heat exchanger that replaced no fewer than 12 shell-and-tube units.

High-performance heat recovery and hydraulics increased throughput by 50%, while retaining all the existing ancillary equipment, such as heaters and compressors. The investment was paid off within months.

Alfa Laval Packinox heat exchangers

High-temperature, high-pressure performance



Alfa Laval Packinox heat exchangers are among the largest in the world, often as high as a six-storey building. Their enormous size is due to the huge temperature difference from start to end – normally up to several hundred degrees centigrade.

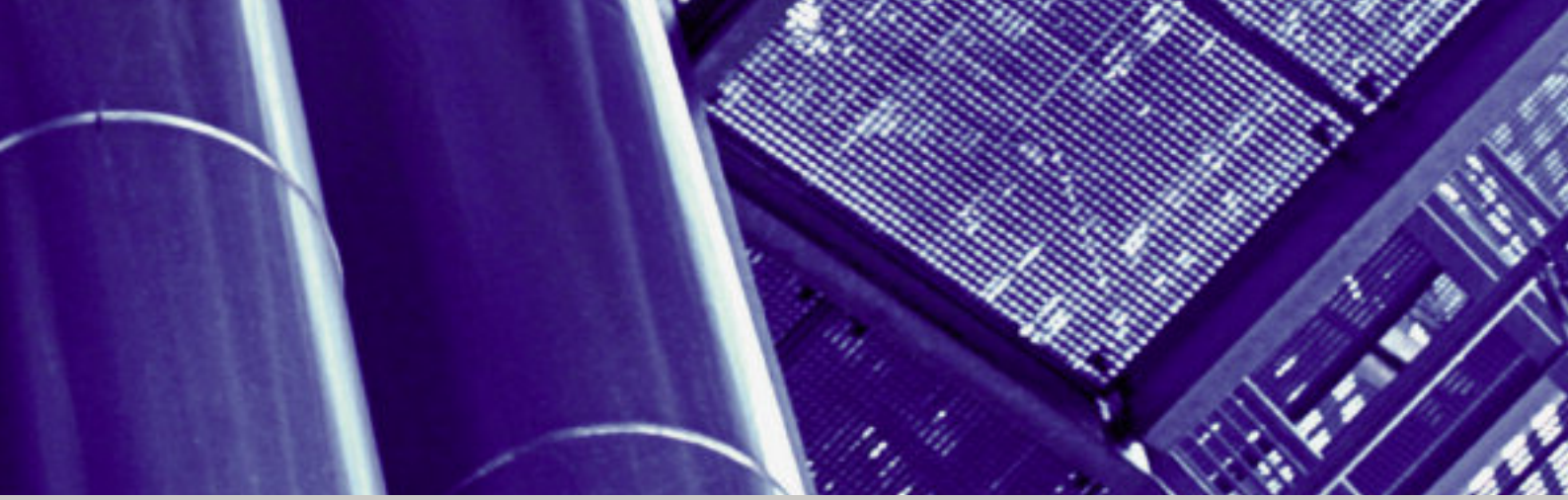
Nevertheless, the Packinox design is actually very compact in relation to the heat transfer surface area. They are tiny compared with any shell-and-tube alternative, resulting in major savings in both infrastructure and installation costs.

Performance payoff

A US refinery was experiencing heavy fouling on its Alfa Laval Packinox heat exchangers due to improperly hydrotreated naphtha and oxygenated olefins. The heat exchanger was then completely cleaned by *in situ* steam-air decoking supplied by Alfa Laval Packinox.

This controlled combustion (decoke) made it possible to rapidly return to the original process performance.





Alfa Laval Packinox advantages

- High thermal and hydraulic efficiency
- Very large heat transfer surface in a compact space
- Single unit can replace multiple larger shell-and-tube installations
- High-temperature and high-pressure operation
- Simplified installation, less infrastructure required
- Minimal maintenance requirements.

Mechanical data

Design pressure

120 barg (1700 psig).

Maximum pressure difference between media 30 bar (430 psi)

Design temperature

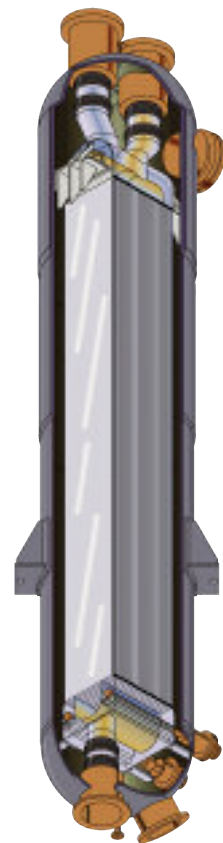
650°C (1200°F)

Alfa Laval Packinox heat exchangers feature a unique design that combines the high-temperature and high-pressure performance of shell-and-tubes with the thermal and hydraulic efficiency of plate heat exchanger technology – all within a compact, large-capacity design. The result is highly efficient heat recovery with an extremely low pressure drop.

Bundle inside pressure vessel

The Alfa Laval Packinox design consists of a fully welded plate heat exchanger placed within a pressure vessel. This vessel contains a higher-pressure fluid that keeps the plate block under compression while the counter-current heat transfer process takes place within. This makes it possible to operate at temperatures and pressures inconceivable for other all-welded plate heat exchangers.

The design ensures both high efficiency and high operating safety, with near-minimal risk of fire, leaks or harmful emissions. This is an important consideration in refineries.



Alfa Laval Compabloc

Compact, high-efficiency all-welded plate heat exchangers



The Alfa Laval Compabloc all-welded heat exchanger design completely does away with gaskets between the plates, making it ideal for many process duties in refineries.

Construction

The heat transfer area of Compabloc units consists of a stack of corrugated plates, laser-welded alternately to form channels. The high thermal efficiency of the design permits the use of stainless steel, titanium and other exotic materials for the heat transfer area, at an affordable cost.

Compabloc is available with heat transfer areas ranging from 0.7 to 320 m² (7 to 3,450 ft²) per unit.

The Compabloc frame consists of four corner girders, top and bottom heads and four side panels with nozzle connections. These are bolted together and can be quickly taken apart for inspection, service and cleaning. The nozzle size is variable and can be selected independently for each side.

Flexible flow arrangement

The overall flow arrangement is counter-current for a multipass unit, though co-current operation is also possible. Each pass is separated from the adjacent passes by a baffle that forces the fluid to turn between the plate pack and the panel.

The different nozzle sizes and flexible pass arrangements make the Compabloc design suitable for liquid-to-liquid duties with dissimilar flow rates as well as for condensing and reboiling duties.



Low-maintenance efficiency

A Compabloc unit is in operation at a major refinery in Japan for cooling clarified slurry oil from the bottom of the main fractionator in the FCC. The heat exchangers previously used failed due to corrosion caused by the high chloride content in the cooling water.

The high thermal efficiency of the Compabloc design made it economical to use corrosion-resistant titanium. As a result, this Compabloc has been in continuous service since 2001, with no service or maintenance required.

Mechanical data

Design pressure

Full vacuum to 35 barg (507 psig)

Design temperature

Max. 350°C (572°F), min. -29°C (-20°F) ASME, -40°C (-40°F)

PED/CE

Alfa Laval Compabloc advantages

- All-welded construction
- Large heat transfer surface in a compact space
- Manufactured in corrosion-resistant materials
- High degree of heat recovery possible
- Heat transfer surface easily accessible for mechanical cleaning.



Alfa Laval spiral heat exchangers

From dirty fluids to high-vacuum condensation

Unique shape, unique properties

Spiral heat exchangers are particularly useful with media that cause fouling, because of the unique self-cleaning effect of the spiral flow pattern.

A spiral heat exchanger is precisely what it says – a circular heat exchanger with two concentric spiral channels, one for each fluid. The curved fluid channels provide optimum heat transfer and flow conditions for a wide variety of fluids, while keeping the overall size of the unit to a minimum.

This allows fully counter-current flow in which one of the fluids enters at the centre of the spiral body and flows towards the periphery. The other fluid enters at the periphery and moves towards the centre.

This results in maximum heat transfer efficiency and makes it possible to operate with temperature cross, while only taking up a minimum of space.

Alfa Laval spiral heat exchangers are ideal for liquid-to-liquid duties with dissimilar flow rates as well as for condensing and for certain reboiling duties.

What goes in must come out

In a spiral heat exchanger, both fluids in the heat transfer process occupy a single channel. There is therefore no risk of a fluid diverting to other parallel channels in case of fouling. Any restriction in the channel created by fouling increases the shear stress at that exact point, creating a scrubbing action that removes the blockage. This makes Alfa Laval spiral heat exchangers effectively self-cleaning.



Alfa Laval spiral heat exchanger advantages

- Self-cleaning effect ensures continuous operation
- Easy access to heat transfer surface, resulting in low maintenance cost
- Compact design results in low installation cost.

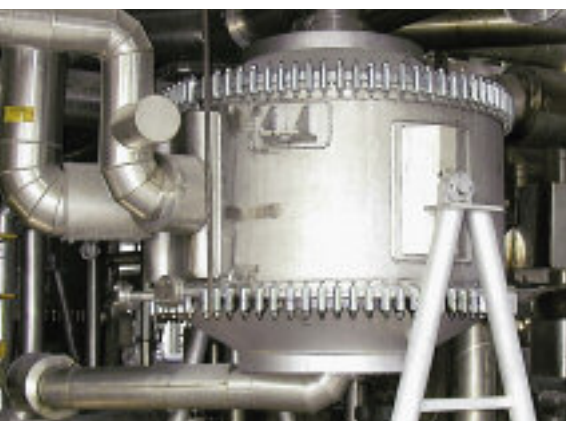
Mechanical data

Design pressure

Full vacuum to 30 barg
unbalanced pressure,
50 barg balanced pressure

Design temperature

-100°C (-150°F) to 400°C (750°F)



Reduced maintenance slices payback time

A significant feature of spiral heat exchangers is their ability to handle media that contain suspended solids, without getting clogged up. TOTAL Raffinerie Mitteldeutschland GmbH in Germany took advantage of this feature when the company installed Alfa Laval spiral heat exchangers in its fluid catalytic cracking (FCC) unit, thus drastically reducing both downtime and maintenance costs.

The savings in service costs during the first year of operation alone amounted to the capital cost for the spiral exchangers, representing excellent payback time.

Determined to reduce downtime?

Global supplier of low-maintenance solutions

With ten manufacturing centres for all-welded heat exchangers located throughout the world, and backed by forty specialist service centres, Alfa Laval is a global provider of all-welded plate-type heat exchanger solutions – with expertise always on the spot when needed.



Global certification

Alfa Laval all-welded plate-type heat exchangers meet the requirements of the European Pressure Equipment Directive (PED) and are manufactured in accordance with pressure vessel codes that include AD2000, ASME VIII (including U-stamp), PD5500 and AS1210.

Production facilities are certified in accordance with the ISO 9001 quality assurance standard and the ISO 14001 environmental management standard, and have also been awarded Russian GOST approval.



Reliability counts

In refinery operations, downtime is almost always extremely expensive. Compared with traditional equipment, Alfa Laval all-welded solutions require vastly less service and maintenance. And when any maintenance is actually done, it is a significantly quicker operation than with conventional heat exchangers.

The basic design of Alfa Laval all-welded heat exchangers completely does away with gaskets, eliminating all the time and labour-consuming problems associated with gasket monitoring, maintenance and replacement.



Downtime drastically reduced

A Compabloc heat exchanger replaced a shell-and-tube unit that was experiencing heavy fouling problems in the sour water treatment plant at Eni's Gela refinery in Italy, where part of the sour water derives from the coker.

With the Compabloc, the cleaning frequency was reduced to less than 10% of the previous requirement. In addition, the downtime caused by cleaning is now only half a day compared with two whole days for the shell-and-tube heat exchanger.

All-welded – and therefore gasket-free – designs also mean that Alfa Laval heat exchanger solutions operate much more reliably with aggressive media and at higher temperatures and pressures.

Easier to clean

These heat exchanger designs are easily accessible for any service and maintenance that may be required. There is no need for all the space required for extracting and cleaning the tube bundle in comparable shell-and-tube units.

Both service time and manpower requirements are also minimal. The entire heat transfer area is easy to clean using standard CIP procedures, high-pressure cleaning equipment or decoking by patented controlled combustion. Due to the corrosion-resistant materials, a wide selection of cleaning chemicals can be used.

Safety boost

One single compact Alfa Laval all-welded plate-type heat exchanger can often be used to replace several much larger shell-and-tube units, reducing the amount of piping and the number of valves and flanges required.

In addition to resulting in less maintenance, this greatly reduces the risk of leaks of combustible vapour or other undesirable emissions as well as the risk of fire or explosion that can result from these. This represents a major step forward in plant safety and in the reduction of environmental impacts.



Alfa Laval automatic strainer

Installing an Alfa Laval back-washing strainer on the cooling water circuit protects against debris entering into heat exchangers. This strainer unit is available in sizes that can deal with up to 5000 m³/hr of water, with hole or wire-rod mesh available from 0.5 to 2.5 mm. The strainers can be used for all types of cooling water, including cooling tower water, and water from the sea, lakes and rivers.

The automatic back-washing function is controlled either pneumatically or electrically, to explosion-proof standard. The back-washing sequence takes place without interrupting the process operation. The strainer is installed as an integral part of the pipework and only takes up a minimum of space.

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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