

# Packinox for hydrodesulfurization

Replacing the shell-and-tube heat exchanger train in a hydrodesulfurization plant with an Alfa Laval Packinox is a straightforward way to reduce energy consumption and CO<sub>2</sub> emissions, as well as increase production capacity. The integrated PlateWash defouling system makes Packinox ideal for all types of HDS processes.



### Reduce energy consumption

The middle-distillates hydrodesulfurization (HDS) plant is a significant energy consumer in a refinery. To reduce costs and enhance environmental sustainability, an increasing number of refineries are optimizing energy recovery in their HDS plants, leading to substantial energy savings.

The key factor is the thermal efficiency of the reactor feed/effluent heat exchanger. With higher efficiency, more energy is recovered and put to use in the process instead of being cooled off. This, in turn, means less fuel must be burnt in the heater to reach the specified feed temperature.

Replacing an existing shell-and-tube heat exchanger train with a single Packinox heat exchanger results in substantially increased thermal efficiency and enhanced heat recovery.

A Packinox has a hot approach temperature (HAT) as low as 5°C (9°F), compared to 30°C (54°F) for a shell-and-tube solution. This leads to up to 80% lower fuel gas consumption in the reactor preheater and a corresponding decrease in CO<sub>2</sub> emissions. In the case of exothermal processes, the savings can reach up to 100%, meaning fuel gas firing no longer is required.

### Boost capacity

Reactor preheater and compressor capacity are often the limiting factors in HDS processes, and upgrading these types of equipment is costly. Instead, the most straightforward and cost-efficient way to debottleneck the process to exchange the existing shell-and-tube heat exchanger train for a Packinox heat exchanger.

The significantly higher thermal efficiency and extra heat recovery free up both heating and cooling capacity, enabling increased throughput. Thanks to the lower pressure drop in a Packinox heat exchanger, the existing compressor capacity suffices at the increased production rate, meaning no additional equipment investments are required.



### PlateWash

Washing system that eliminates the risk of fouling

### PlateWash maximizes uptime

Many HDS units suffer from build-up of ammonium salts on the effluent side of the heat exchanger at low temperatures. With Alfa Laval's unique PlateWash system, this is no longer a problem.

Alfa Laval PlateWash is an integrated plate cleaning system for Packinox, specifically developed to mitigate ammonium salt fouling issues in HDS processes. The system monitors the pressure drop in the heat exchanger, enabling operators to initiate water washing as soon as ammonium salt fouling begins to accumulate. After a few hours of flushing, the plates are clean again and the water spray is turned off. The washing process is performed during operation to maximize thermal efficiency over time and avoid costly, unplanned downtime for cleaning.

Thanks to PlateWash, Packinox technology delivers the same outstanding performance over time in all types of HDS processes.

### Typical process layout

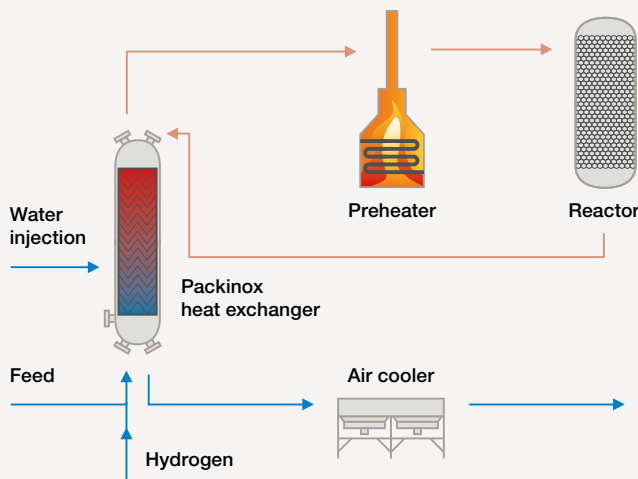


Figure 1. Replacing an existing shell-and-tube heat exchanger train with a single Packinox increases heat recovery dramatically and leads to a reduction in fuel gas consumption in the reactor preheater of up to 100%. It also frees up capacity in the heater and cooler, resulting in higher production capacity if heating or cooling is a bottleneck.

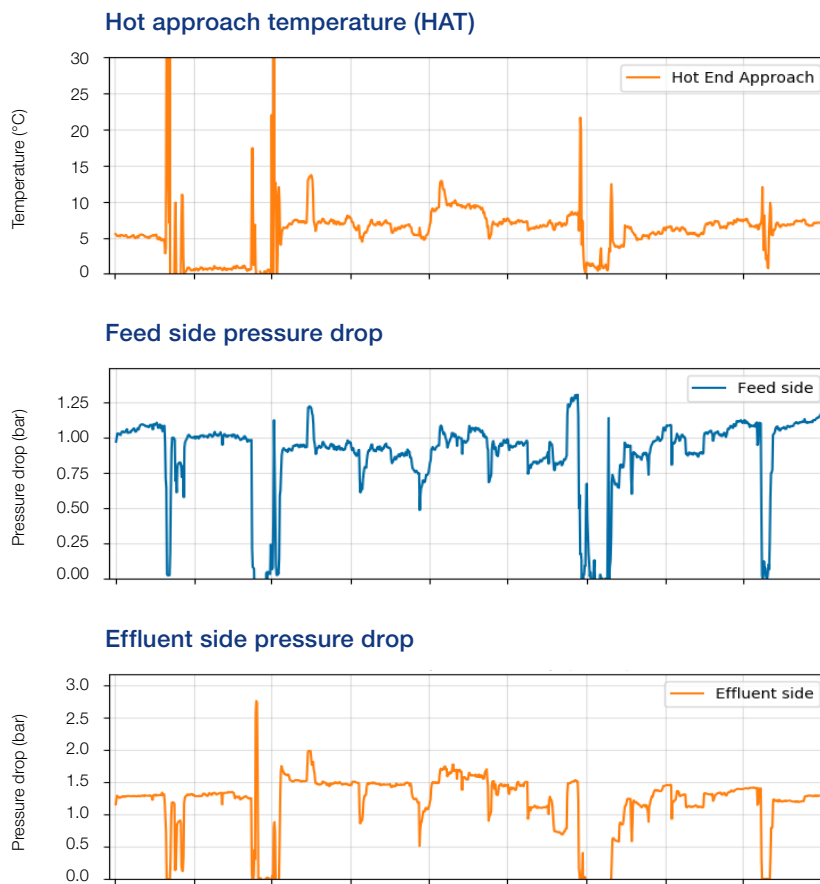


Figure 2. The diagrams illustrate the steady performance of a Packinox unit that has been in operation since 2011. The diagrams show the hot approach temperature and pressure drops on the feed and effluent sides between September 2018 to September 2021.

### Full insight with Packinox Performa

The unique Packinox Performa software gives operators a real-time view of the operation and condition of their Packinox heat exchangers, as well as performance predictions. This makes it easy to optimize maintenance, ensure reliable uptime, and maximize energy efficiency.

### Well-proven in HDS applications

Packinox heat exchangers have been successfully used in refineries for more than 40 years, delivering reliable performance and large energy savings year after year.

Alfa Laval has supplied Packinox units for HDS plants for more than two decades. The oldest has been in operation since July 2001 and is still delivering top performance. There are currently (2024) 17 Packinox units in operation in HDS units across the world, and seven of these have been in operation for more than 15 years.

The diagram in figure 2 shows the HAT and pressure drop over time for a Packinox unit that has been in operation since 2011. Thanks to the robust design and minimal fouling, performance has been steady over the years.

### CAPEX savings

In addition to its high thermal efficiency, an Alfa Laval Packinox heat exchanger is also significantly more compact than a shell-and-tube solution. A single Packinox can replace multiple shell-and-tubes and consequently, the costs associated with plot space, civil engineering, structures, and piping are significantly reduced when constructing a new plant.

In revamp projects where shell-and-tube heat exchangers are replaced with a Packinox, there is typically no need to upgrade existing equipment like compressors and heaters.

### Knowhow and experience

All Alfa Laval Packinox heat exchangers are fully customized and optimized for high reliability and performance. We have close cooperations with some of the world's leading licensors and understand the challenges faced by refineries.

We put all our knowledge and experience into the design of each heat exchanger to make sure our customers get the best possible solution in terms of low total cost of ownership and maximum production capacity.

### Example – Revamp of 50,000 bpd HDS unit

	Shell & tube HEX HAT = 30°C (54°F)	Packinox HEX HAT = 5°C (9°F)
Number of shells	4–5	1
Heat exchanger duty	30.4 Gcal/h (120 MMBTU/h)	37.5 Gcal/h (148 MMBTU/h)
Additional heat recovery	–	7.1 Gcal/h (28 MMBTU/h)
Reduction in fuel gas consumption	–	5,860 tonnes/year
Reduction in CO <sub>2</sub> emissions	–	16,000 tonnes/year
<b>Capex</b>		
Equipment cost	–	3,300,000 EUR
Installation cost	–	1,500,000 EUR
Total installed cost	–	4,800,000 EUR
<b>Opex***</b>		
Fuel savings per year *	–	3,800,000 EUR
CO <sub>2</sub> savings per year **	–	880,000 EUR
<b>Return on investment</b>		
Payback time		1.1 years
Internal rate of return		70%
Net present value @3% discount rate		47,000,000 EUR

\* Assumed fuel price = US\$660/tonne

\*\* Assumed CO<sub>2</sub> price = US\$50/tonne

\*\*\* Power savings (air cooler and recycle compressor) are not considered in this evaluation

### Packinox compared to shell-and-tube heat exchangers

Type	Min. HAT	ΔP (both sides)	Cleaning during operation	Req. no. of units	Req. installation space
Packinox	5°C (9°F)	2 bar	Yes	1	Small
Shell-and-tube HEX train	30°C (54°F)	4 bar	Yes	4–5	Large

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