Making heavy crude oil profitable

The X-Series disc-stack centrifuges

A new, revolutionary solution for heavy crude oil

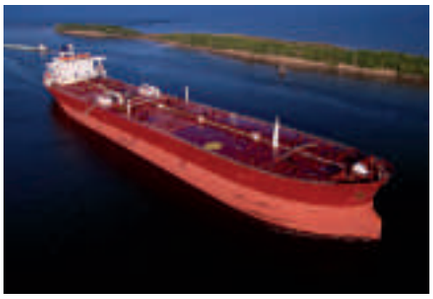
The need to exploit heavy crude oil reserves increases every year. However, processing heavy crude oil to levels that meet with pipeline specifications has always been a costly and time-consuming process. Until now.

The X-Series disc-stack centrifuges not only represent new equipment that will help to more efficiently utilize these reserves, but more importantly, they also represent a revolutionary new process for creating refinery-spec oil from heavy crude oil.

Based on Alfa Laval's expertise in separation processes and extensive experience in the oil industry, an X-Series disc-stack centrifuge provides a better, more economical separation solution for oil dehydration and water de-oiling than traditional settling tanks.

Effective for both onshore facilities and offshore installations i.e. platforms and FPSOs, its high throughput allows for instance a single X20 module to effectively and reliably process up to 25,000 bpd (170 m^3/h).

And its space-saving design provides added benefits, especially for offshore facilities where space and weight allowances are at a premium.



Giving you better process control

Immediate feedback on oil quality and the capability to fine-tune the process on the fly ensures you receive a saleable product every time.

Always run on spec

Heavy crude oil presents a number of separation challenges not found in other oil. Stable emulsions, particles, high viscosity and small density differences between the oil and water make separation difficult, with inconsistent outcomes.

Using little or no production chemicals, an Alfa Laval X-Series centrifuge produces 5000–8000 G of centrifugal force to separate oil from water and ultra-fine solids in a matter of seconds. In fact, it can effectively remove the smallest stabilized particles and water droplets, and do it in a fraction of the time of traditional methods. The result is a more consistent, reliable and saleable product, even from heavy crude oils with API gravities as low as 11.5°.

The robustness and performance of Alfa Laval's heavy crude systems can also be effectively applied to a number of different weights of oil, from light to heavy, as well as to water treatment and other recovery-side operations.

And unlike traditional methods, the X-Series centrifuges allow you to fine-tune the process during operation, ensuring that you are always running on spec.

A proven, more versatile solution for land and sea

Already in use at facilities around the globe, Alfa Laval's heavy crude systems can be applied to almost all heavy crude oil processes from offshore to land-based production, such as In-situ recovery processes (e.g. SAGD – steam assisted gravity drainage), and mined oil sand production, as well as slop oil.

And their outstanding performance profile considerably increases the efficiency and reliability of producing refinery-spec crude oil.

Plus, as the feed properties change during a typical field life, the same centrifuge that processed heavy crude oil can be easily configured to process produced and oily water.

In fact, one of the biggest challenges of produced and oily water is the small oil droplet size, which makes traditional methods time consuming and less reliable. However, Alfa Laval's advanced centrifugal technology provides maximum cleaning of treated water.

Smaller and more environmentally friendly

Size does matter. Especially when it comes to offshore facilities. A typical X-Series five-module system has a footprint of only 60m^2 and a throughput of nearly 125,000 bpd or 850 m^3/h.

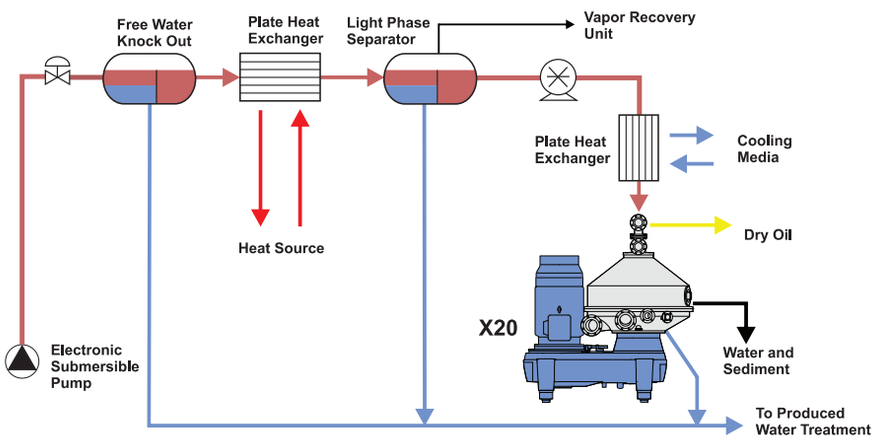
It takes up about a fourth of the space and 10–20% of the wet weight of traditional methods while providing better, more reliable separation performance.

In addition, disc-stack centrifuge technology requires little to no production chemicals (i.e., demulsifiers) or wash water, making the process, as a whole, more environmentally responsible.

The Alfa Laval heavy crude system

- The total fluid stream produced by a well is fed to the free-water knockout to remove the bulk of the free water
- The resulting heavy-phase liquid discharged from the free-water knockout is further treated in the water treatment system
- The partly dehydrated liquid is heated to be further dehydrated and de-gassed in the light-phase separator
- The dehydrated liquid is cooled, if needed, before entering the Alfa Laval disc-stack centrifuge
- The dry oil output is routed directly to the oil export line.

The Alfa Laval heavy crude system



Heavy-duty design

Alfa Laval centrifuges are built to last. In fact, each X-Series system is built to meet the rigorous requirements of offshore specifications, regardless of its ultimate operation environment.

More effective from the start
Wet crude oil is fed through the feed inlet to the OPTIFLOW™ disc inlet, which gently accelerates the liquid while preventing shearing, droplet splitting and foaming. In addition, less gas becomes trapped in the liquid.

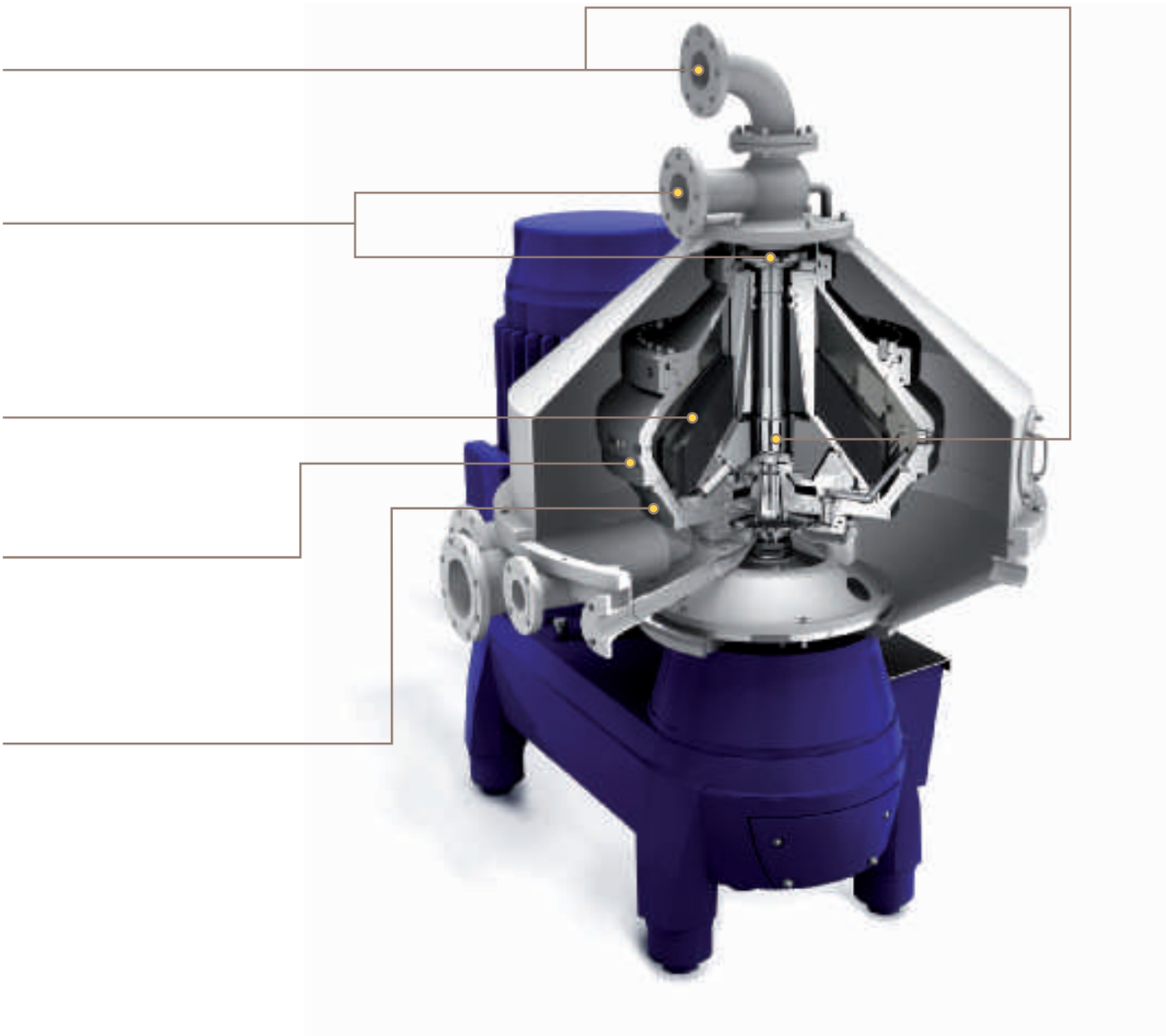
Centrifugal force at work
Purified oil moves towards the centre of the bowl and exits through a paring disc into the oil outlet pipe.

Unmatched performance
Liquid enters the rotating separator bowl and disc-stack, where particles and water separate outwards along the discs towards the periphery of the bowl. The design of the disc-stack enables separation of water and solids from oil in counter-current liquid layers at high rates and is capable of removing the smallest particles and water droplets.

Efficient design
Specially designed nozzles allow continuous discharge of high solid content. In addition, some energy is recovered due to the tangential direction of the nozzle spray, thus reducing power draw. Discharge is then flushed through the nozzle water outlet in the bowl casing.

Built to last
The bowl exterior as well as all the critical parts in the flow path, including the internal distributor and heavy phase tubes, are coated with metal carbide to prevent erosion.

Total control
Connected outside the centrifuge, the patented OPTIPHASER™ system automatically controls the oil-water interface during operation by compensating for changes in the flow rate and feed composition, enabling external on-line optimization of separation performance and product quality.



Building products, solutions and partnerships that last

Alfa Laval is committed to providing solutions to your toughest challenges.

Savings throughout the process
The X-Series centrifuges reduce many of the operational costs typically associated with heavy crude oil separation. The savings start with better quality crude oil, which doesn't need to be sold at a discount.

In addition, the X-Series centrifuges produce significant savings in operational costs. With their high separation efficiency, less heat needs to be supplied to the process, considerably reducing oil and gas consumption.

Realize savings from:
- Significantly reduced settling times
- The reduction in the use of production chemicals
- A dramatic reduction in wash-water usage.

Moreover, savings are realized in the construction phase of the oil dehydration process due to the reduction in the amount of material and civil costs involved, compared to traditional settling tanks.

But none of this is possible if your process is not working efficiently and reliably. That's why we put as much effort into developing service and operational support as we do researching and developing products for you.

Nonstop performance
We understand the costs involved in shutting down your operations even for a few hours. That's why we recommend planned maintenance through our Performance Agreements. We customize our service agreements based on the operating environment of the system and your need, from basic service to predictive maintenance. Not only is it less costly, overall, to prevent equipment shutdown, but it also keeps your Alfa Laval centrifuges and facilities operating at peak performance year after year.

Global availability
Our global spare parts centres and network of service locations in more than 50 countries, as well as the availability of service people with offshore licenses, ensure you receive short response times and maximized uptime.

A lifetime commitment
For over 100 years, Alfa Laval's success has been based on partnering with customers and working together for their long-term success. We can help you efficiently and effectively set up your entire oil processing system, for both onshore and offshore facilities. And we'll customize the separation solution to meet your specific goals, whether it's processing oil sands or treating crude oil and produced water on your offshore facility.

Squeezing oil from sand

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Using Alfa Laval's centrifuge technology at the Athabasca Oil Sands Deposit, Syncrude Canada Ltd. is able to efficiently process the oil sands and separate the bitumen to refinery standards for upgrading.

And by working closely with Syncrude, Alfa Laval has customized the centrifuge design over time, making it more effective and durable for Syncrude's extreme environment.

A frustrating situation
Containing an estimated 1.6–2.5 trillion barrels of heavy crude oil, the largest single oil deposit on earth is located in Alberta, Canada, on the Athabasca Oil Sands Deposit. At current consumption levels, that is enough crude oil to supply Canada for the next 400+ years.

However, there are many challenges in removing the oil from the sand, and then refining the resulting asphalt-like bitumen into refinery-standard crude oil.

Separation of the highly-viscous bitumen is difficult. Erosive solids must be removed to avoid extensive wear to equipment. In addition, chlorides must be removed to control corrosion in the upgrading process.

Syncrude developed a separation process resulting in a bitumen froth that contained water and other tailings. At this stage, they needed a highly efficient, reliable, and compact solution to help turn the bitumen into refinery-standard crude oil.

Alfa Laval creates the solution
Alfa Laval developed a two-stage separation process for the bitumen froth. Using Alfa Laval's centrifuge technology, Syncrude is able to efficiently process asphalt-like bitumen into a low-chloride product that contains less than 0.6% solids and 2% water.

Moreover, Alfa Laval's patented OPTIPHASER technology dramatically increases the efficiency of the operation by maintaining efficient performance despite changes in the froth composition.

The OPTIFLOW inlet technology ensures gentle inlet conditions and efficient separation.

Partnering for success
Since there is a large variation in the feed composition, Alfa Laval worked with Syncrude to develop special control valves (OPTIPHASER) for the centrifuges. The control valves automatically add or remove water through the heavy phase paring disc device, maintaining constant optimized conditions that significantly minimize downtime and reduce oil losses.

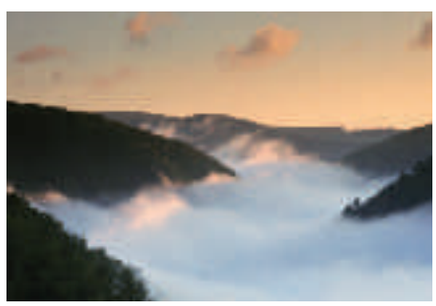
Working with the environment

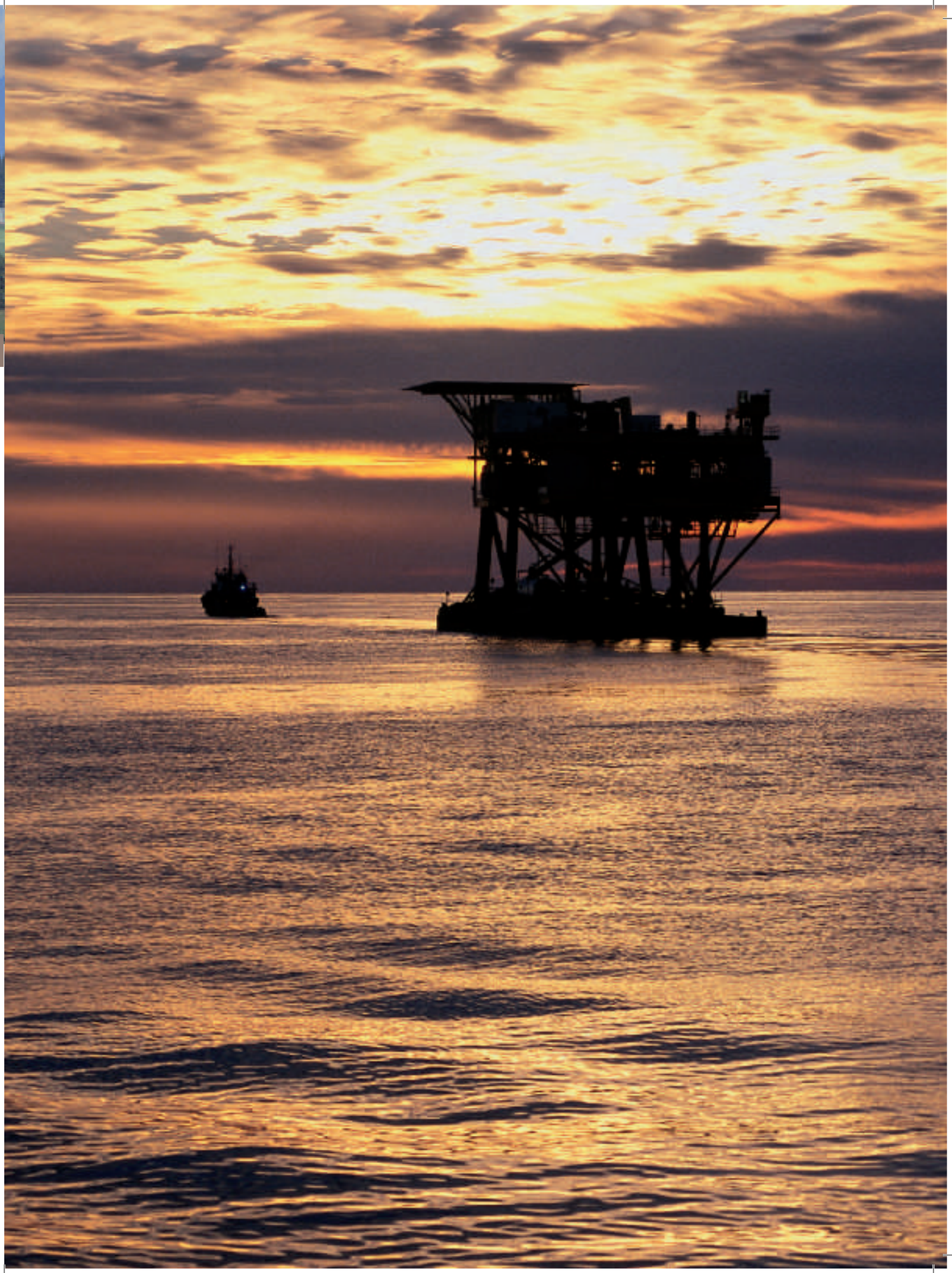
Nothing can shut down a facility quicker than not being compliant with environmental regulations. Our new process for heavy crude oil dehydration helps you achieve the highest levels of oil recovery while significantly reducing tailings treatment costs, produced water contamination, and CO_2 emissions. The result is a more environmentally sound solution.

Alfa Laval X-Series centrifuges save environmental resources by using dramatically less wash-water than traditional methods. And thanks to its high separation efficiency, it uses fewer – and in some cases no – production chemicals, making it a more environmentally friendly process.

The high separation efficiency makes it possible to operate at significantly lower temperatures and burn less oil or gas than conventional equipment. This dramatically reduces the amount of CO_2 emissions for each barrel of oil produced.

Plus, with the centrifuge's ability to be fine-tuned during operation, you can be sure that your system is always running according to any environmental specifications.





About Alfa Laval

Alfa Laval is a leading global provider of specialized products and engineered solutions. Our equipment, systems and services are dedicated to helping customers 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

For up-to-date Alfa Laval contact information for all countries, please visit our website at www.alfalaval.com

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