

# here

# GAS

# THE NEW OIL?

## TRIPLE-E

World's biggest cargo ship is also greenest

## SOY SAUCE

New methods revolutionize ancient process

## DATA CENTRES

Cool solution cuts carbon emissions by 90 percent

# 12

### **The green colossus**

Maersk Line's record-breaking Triple-E is the most energy-efficient way of moving cargo around the planet.



#### **4 THEME: GAS. Redrawing the energy map**

Technological advances have led to a natural gas boom that could have widespread global effects.

#### **9 THEME: GAS. Safety is priority one**

The risk of incidents is ever present, so how does the gas industry tackle its safety challenges?

#### **25 The green vertical city**

Alfa Laval solutions help Shanghai Tower reach its sustainability goals.

#### **26 A cooling revolution**

Alfa Laval's new T35/TS35 brings multiple benefits to a wide range of industries.

#### **27 The great soy sauce shake-up**

High-speed separators improve production of highly traditional Chinese condiment.

#### **31 Taking the CO<sub>2</sub> out of IT**

Iceotope's liquid cooling for data centre servers makes web surfing more sustainable.



# 18

## A nose for innovation

Major South African winery gets unexpected benefits from a switch to decanter technology.



# 22

## Profit from waste

Derek Clark's experience at sea saves money and cuts oil waste on the railways.

# Gas rises

**editorial**

Natural gas is becoming increasingly important in the global energy mix, and now stands for a quarter of the world's total energy supply. Gas demand is expected to increase by roughly 50 percent over the next ten years, exceeding the demand for coal by 2030 and approaching the demand for oil by 2035.

Why? It is the cleanest fossil fuel, and cheaper than oil. But equally important are the new drilling techniques and technologies that make it possible to extract deposits that were previously inaccessible – locked in shale formations or deep under the seafloor. The limits of what is possible in this industry are constantly being stretched.

Shell's Prelude FLNG, the world's first floating liquefied natural gas facility, is one example. Producing gas offshore under extreme conditions puts heavy demands on equipment, and Alfa Laval is proud to be contributing to the Prelude FLNG project. We will have assorted solutions on board when the vessel becomes operational off the Australian coast in 2017 (read more on page 8).

**ALFA LAVAL HAS BEEN WORKING** in the gas sector for more than 40 years and has built up a long-term relationship with the major players. We have products and solutions for all steps of the gas chain – from drilling and processing to transport and usage – and the in-depth application knowledge necessary to serve this growing industry.

We have been strengthening our offer to the natural gas industry in recent years, both through our own research and development and through acquisitions. Most recently, Alfa Laval has broadened its portfolio through the acquisition of niche companies Vortex System, ACE and Niagara Blower.



As we report in this edition of *here*, we are also present with environmental and energy-efficient solutions on Maersk's Triple-E. Not only are they the largest ships in the world, they are also among the greenest. Our products and solutions help reduce Triple-E's fuel consumption, but also protect the marine environment from the spread of invasive species.

**FINDING INNOVATIVE SOLUTIONS** to our customers' future challenges is what we do every day. Finding new solutions for long-established processes can be even more challenging. In this issue you can also read about traditional wine and soy sauce production processes where Alfa Laval has supplied new and innovative solutions. We've helped make these processes more energy efficient and more profitable but also, importantly, improved the quality of the end product.

I hope you enjoy the magazine.

**SVANTE KARLSSON**  
EXECUTIVE VICE PRESIDENT PROCESS  
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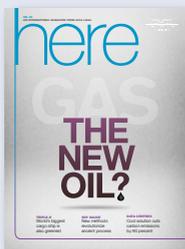
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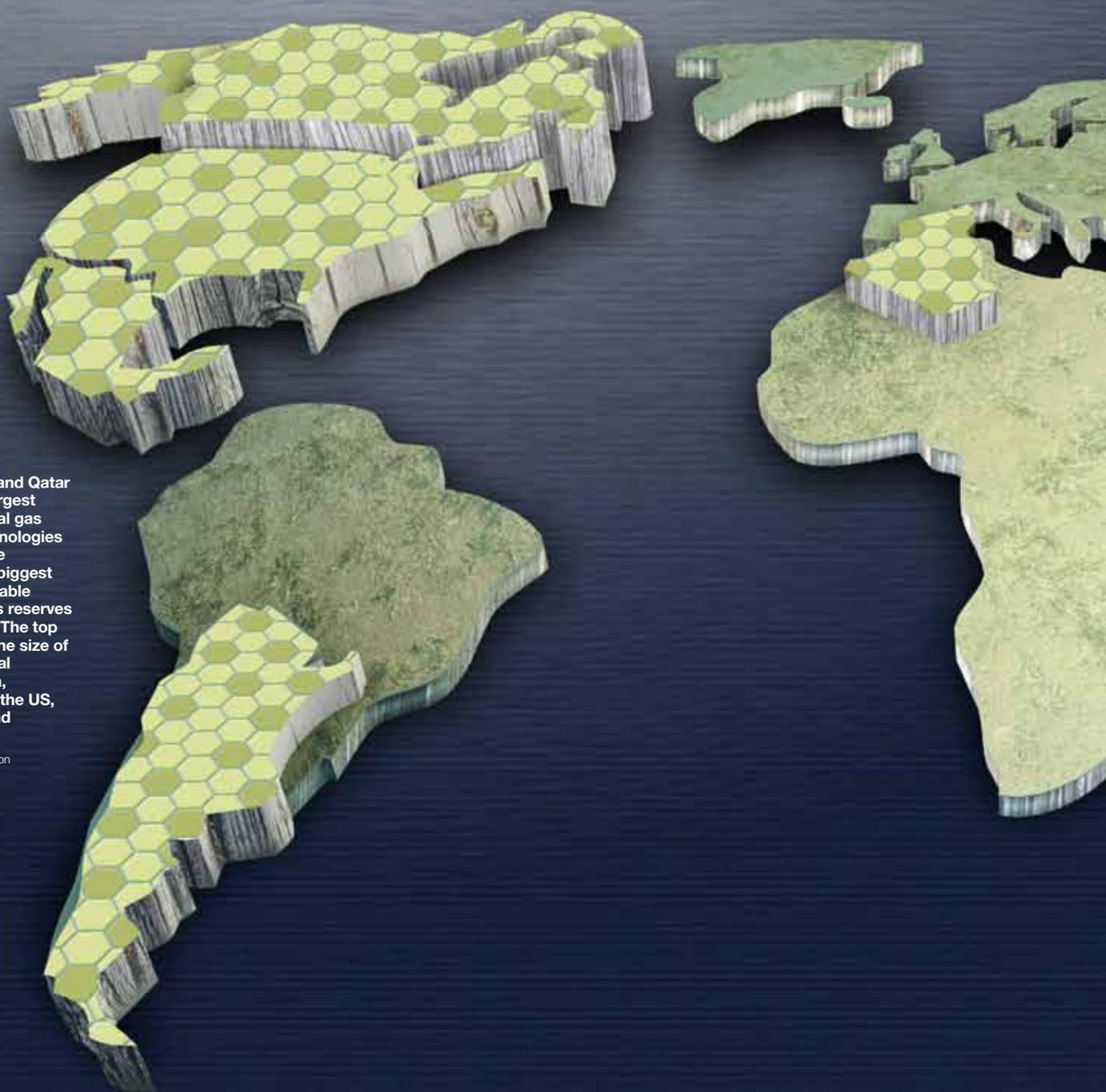
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# A NEW WORLD

How natural gas is redrawing the energy map



While Iran, Russia and Qatar have the world's largest conventional natural gas reserves, new technologies could transform the countries with the biggest technically recoverable unconventional gas reserves into energy giants. The top seven, in order of the size of their unconventional reserves, are China, Argentina, Algeria, the US, Canada, Mexico and Australia.

Source: US Energy Information Administration, June 2013.

# OF ENERGY



Revolutionary advances in technology are opening up vast reserves of natural gas previously out of reach to human exploitation.

The second coming of this familiar resource is already redrawing the world energy map. Could natural gas be poised to challenge oil as the most important fuel source on the planet?

TEXT: **GREG McIVOR** ILLUSTRATIONS: **ERICKTON & PETTER LÖNEGÅRD**  
PHOTOS: **SHELL, JIM BLECHA & JON MULLEN**



It's colourless, virtually odourless and definitely not to be sniffed at. Just as we were contemplating life beyond oil and a transition to renewables, natural gas is poised to enter a golden age that could transform world energy markets for decades to come.

The reason is technology. Natural gas has been an important energy source for decades, but new and improved drilling techniques are enabling producers to extract gas from vast, once-inaccessible deposits locked in shale formations far underground, and from offshore deep-water wells thousands of metres below the waves.

The technology boom began in the United States in the 1990s and in a few short years has transformed the energy market there. The figures are remarkable: US unconventional gas production – so called because of the new, unconventional technology used to extract it (see sidebar on page 12) – has rocketed from 1 percent of gas production in 2001 to 37 percent in 2011 – and the figure is climbing every year.

Soaring production and discoveries of new unconventional gas reserves have driven US natural gas prices to a 20-year low, creating a new cheap energy source with the potential to make the US self-sufficient in energy and transfigure its energy security. Surging production since the mid-2000s has made the US the world's second-largest natural gas producer in 2011, only just behind Russia.

## UNITED STATES



- has become the world's second-largest natural gas producer

- could soon be self-sufficient in energy

**SHALE GAS** is the largest of three types of unconventional gas.

Found in impermeable shale rock formations, this gas has previously been out of reach to extractors. But the development of new technologies – notably hydraulic fracturing (fracking) – has made these deposits accessible for the first time. The technology is truly groundbreaking – literally and metaphorically. Not only does it make it possible to tap immense new gas reserves, but it is also cheap.

The shale boom has already rejuvenated the US natural gas market. Experts think it might have the potential to do the same globally, creating a global energy revolution. Three countries – China, Argentina and Algeria – actually have larger unconventional gas deposits than the US. They and others like Canada,

Mexico, Australia and South Africa, all stand to make enormous financial gains by adopting fracking.

Industry experts are in no doubt of fracking's potential to change the dynamics of world energy. "The global unconventional shale boom is arguably one of the biggest technology breakthroughs in decades," said Swiss bank Credit Suisse in a recent report.

**WHILE IT IS UNCONVENTIONAL GAS** such as shale that is the main game changer, new techniques and technologies are also opening up new possibilities for extracting previously out-of-reach gas from conventional sources. Shell's floating liquefied natural gas (FLNG) vessel, for example, has the potential to revolutionize the way conventional natural gas resources are developed. When it becomes operational in the Prelude gas field, off Australia's northwest coast, FLNG will help to unlock offshore energy resources without the need to lay pipelines and build processing plants on land.

While FLNG will operate in about 250 metres of water, another way to get to previously untapped gas resources

is to go deeper. Much deeper. It is estimated that some 70 percent of deepwater resources are located at depths of between 2,000 and 4,000 metres, which presents tough technical challenges, such as extremes of pressure and temperature. Earlier this year, plans were announced for the world's deepest offshore floating oil and gas facility off the coast of Louisiana, which will drill in water some three kilometres deep.

Peter Rushworth, in a report from consultants IHS, says that in the last ten years more than half of new global conventional gas reserves were discovered offshore, with the most significant discoveries in Brazil, the US, Angola,

Australia, India, Nigeria, Ghana and Malaysia. "Deepwater and ultra-deepwater discoveries are becoming the dominant source of new reserve additions, accounting for 41 percent of total new reserves," he says. "This trend will likely continue, making offshore – and particularly deepwater – key contributors to new supply growth."

**TECHNICAL ADVANCES** mean that conventional offshore gas production in the US will increase by 35 percent by 2040, according to the US Energy Information Administration. And similar growth is expected in Brazil. But unconventional gas production will grow even more – by 113 percent in the US. Today 86 percent of natural gas globally comes from conventional sources such as offshore wells and 14 percent from unconventional sources such as shale. But this balance is changing – and changing fast. Experts predict fracking will boost the unconventional gas ratio to 32 percent by 2035.

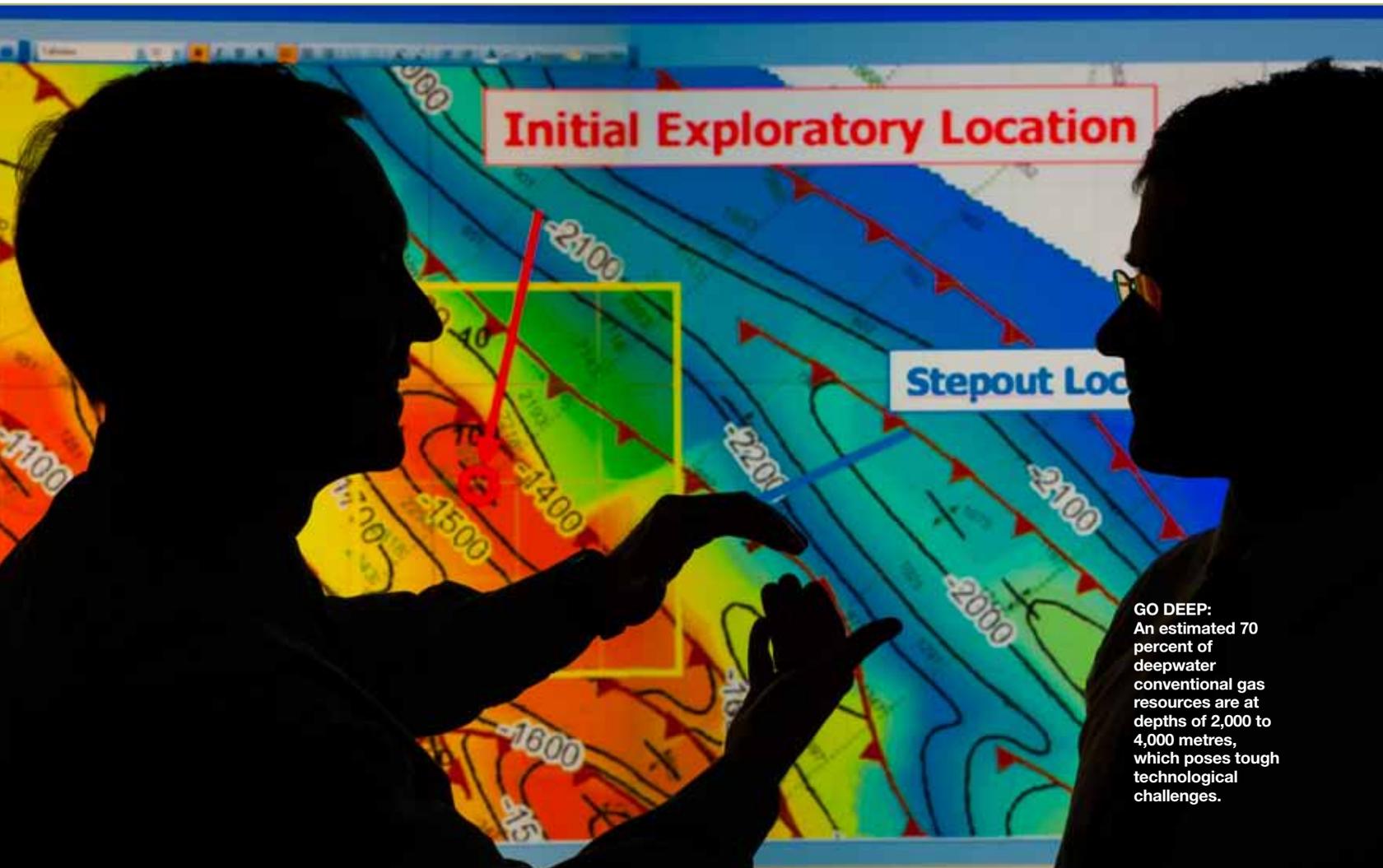
But – and it is a big but – fracking is deeply controver-

## ALFA LAVAL SOLUTIONS

Alfa Laval has solutions for every step of the natural gas chain, both onshore and offshore. From drilling and production to processing, transportation and transmission, its products and solutions recover heat, minimize pollution and increase uptime and safety. For Alfa Laval's complete product portfolio for the gas industry, visit [www.alfalaval.com/industries/oil-and-gas/gas](http://www.alfalaval.com/industries/oil-and-gas/gas)

**“Deepwater and ultra deepwater discoveries are becoming the dominant source of new reserve additions, accounting for 41 percent of total new [conventional] reserves.”**

PETER RUSHWORTH, CONSULTANTS IHS



**GO DEEP:**  
An estimated 70 percent of deepwater conventional gas resources are at depths of 2,000 to 4,000 metres, which poses tough technological challenges.

sial. Environmentalists blame it for groundwater pollution and for causing seismic events including earthquakes. Aside from the impact of fracking itself, many environmentalists oppose an expansion of natural gas because it is non-renewable and, as a hydrocarbon, contributes to global warming when burnt for fuel.

However, natural gas is the cleanest hydrocarbon, emitting less CO<sub>2</sub> than oil and much less than coal. Switching to natural gas from coal and oil would slash world carbon emissions. Thanks in part to natural gas, US emissions of CO<sub>2</sub> associated with energy production have been reduced to their lowest level in years.

**ALAN RILEY, PROFESSOR IN ENERGY LAW** at City University London, believes the shale gas revolution could be the means to blunt the rise of carbon emissions and prevent global warming from reaching catastrophic proportions. “Shale gas emits 50 percent less carbon dioxide than coal, so if countries like China and India make the switch on a large scale, then we have a chance to reset the trajectory of global carbon dioxide emissions.”

Broad development of shale gas resources – with proper ecological safeguards – could, Riley argues, “be the best way to achieve the quick cuts in carbon dioxide emissions that we need to maintain a habitable environment on Earth”.

David Bellman, of All Energy Consulting, agrees, saying that jettisoning a resource that will provide enhanced energy security would be wasteful. Better, he says, to pursue the regulatory frameworks needed to tap shale gas in the most sensible and safe ways possible. “Fracking has to be prudent. You don’t want drilling on a faultline. You still need oversight,” he says. “Ignoring environment concerns is ignoring reality. What we need is pragmatic compromise.”

For although some countries, mainly in Europe, are striving to move beyond fossil fuels, the reality is that hydrocarbons will continue to dominate the energy mix for a long time to come. The indications are that unconventional gas will be so cheap that it will undercut not just fossil alternatives like oil and coal but also renewable fuels like wind and biomass, potentially stunting the international transition to renewables.

**THE GAS REVOLUTION** is redrawing the world energy map and shifting the balance of power. Countries with large unconventional gas reserves, like the US and China, have geopolitical reasons for exploiting the resource on a major scale as it would bolster their energy security by reducing reliance on petrochemical powerhouses like the Gulf countries and Russia.

**CHINA**

- currently relies on coal for up to 80 percent of its power
- has the world’s largest technically recoverable shale gas resources



### NATURAL GAS

**Natural gas can be categorized as either conventional or unconventional – terms that refer not to the nature of the gas itself, but how it is mined.**

■ **Conventional gas** is natural gas occurring in permeable rock types. The porous nature of the rock allows the gas deposits to migrate through the rock and accumulate in pools that can be tapped using conventional techniques – typically by drilling wells.

■ **Offshore deepwater drilling** is defined as oil and gas exploration and production at depths of between 500 and 1,499 metres. Ultra-deepwater covers activities deeper than 1,500 metres.

■ **Unconventional gas** is found in impervious rock, where it is trapped by geological conditions and therefore cannot collect in pools.

It is mined using unconventional extraction techniques such as hydraulic fracturing (fracking), a process which involves pumping fluid into the rock to create pressure that shatters it and enables the gas to be recovered.

Unconventional gas occurs in three forms:

- **Shale gas**
- **Tight gas**
- **Coalbed methane.**

Shale gas is by far the most prevalent of the three and is natural gas trapped within shale formations – fine-grained sedimentary rocks. The shale gas boom is responsible for the recent rejuvenation of the natural gas industry in the United States.

**“Natural gas has electrification potential for a lot of people. Parts of society that didn’t have access to electricity because they couldn’t afford it now have the potential to get it. That’s a huge leap forward.”**

DAVID BELLMAN, ALL ENERGY CONSULTING

Likewise, unconventional gas deposits in East European nations such as Bulgaria, Romania and the Czech Republic have the potential to counterbalance the region’s reliance on gas imports from Russia.

**SO THE CRITICAL QUESTION** is what the global impact of unconventional gas will be. Will the boom spread outside the US and catch on abroad? The answer, according to Credit Suisse, is that it will – but only over the longer term. China has twice the recoverable shale reserves of the US but is still investing heavily in coal. Not until the next decade will Chinese unconventional gas production have the potential to be a game changer, Credit Suisse believes.

The geopolitical repercussions of this

potential reality are hard to gauge. But for hard-pressed American manufacturers, especially those in energy-intensive industries, this cheap new energy source is manna from heaven.

But the implications go beyond industrial gains. In parts of Africa and Latin America, the growth of natural gas could bring electricity to people for the first time. “Natural gas has electrification potential for a lot of people,” says Bellman. “No other electricity generation can beat the cost of capital of a natural gas plant. Parts of society that didn’t have access to electricity because they couldn’t afford it now have the potential to get it. That’s a huge leap forward.” ■

*Additional reporting by David Wiles*



# SAFETY FIRST

Safety is top priority in the offshore gas industry, but accidents still happen – occasionally with disastrous results. How does the industry work with reducing risks, and how successful has it been?

TEXT: DAVID WILES PHOTOS: WIKIMEDIA COMMONS, AKER SOLUTIONS & MAYUMI TERAQ

**O**n July 6, 1988, a series of explosions ripped through the Piper Alpha oil and gas platform off the northeast coast of Scotland. Within two hours 167 men lost their lives, making Piper Alpha the world's worst offshore disaster. Now 25 years later, there has been great progress on safety, but the volatile nature of hydrocarbons means there will always be risks in drilling for, transporting, and processing natural gas.

Ken Arnold, senior technical adviser for WorleyParsons who has nearly 50 years in the oil and gas industry, including 16 at Shell, says the biggest offshore safety issue is loss of containment. "Hydrocarbons are safe if you keep them where they are supposed to be," he says. "The danger comes when they start to leak out. So the greatest effort is to make sure we never lose containment. That possibility is always there, but the goal is to minimize those occurrences."

As with Piper Alpha, most offshore accidents are caused at least partly by human error. "It is documented that 80 to 90 percent of all accidents are due to humans in action," says Arnold. "But you could also say that 80 to 90 percent of accidents are due to design

mistakes. You need to do designs in such a way that if something goes wrong, the natural reaction of the human who has to interface with it is to do the right thing. And that is not always the case."

**TO REDUCE THE CHANCE** of accidents being caused by equipment failure, there is constant demand by oil and gas companies for more reliability from equipment suppliers. "The more reliable equipment is, the safer it is by definition," says Arnold. "Things rarely go wrong when everything is operating as it should. It is in shutdowns, start-ups, construction and maintenance that we expose ourselves to greater risk."

The gas industry is one of the most extreme environments for heat exchangers. In heat transfer applications at gas-sweetening plants – where hydrogen sulphide and carbon dioxide are removed from the gas – temperatures can reach 140°C and pressures sometimes touch 35 bar. Add into the mix highly toxic gases, plus the fact that gas-sweetening systems are among the most challenging duties for polymer gaskets, and there is simply no room for error.

## THEME: NATURAL GAS



A safety check on a gas rig. Up to 90 percent of offshore accidents are caused by human factors.

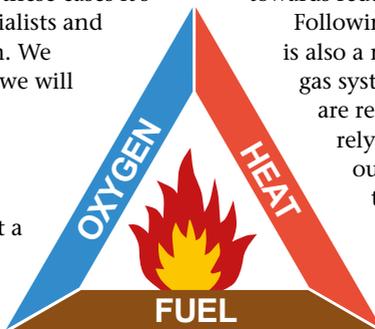
“If there is a leak in a heat exchanger in a dairy, you get spilled milk – and we all know that’s nothing to cry over,” says Magnus Hoffstein, Alfa Laval’s market unit manager for gas. “But if you have a leak in a gas plant it could lead to deaths, so selecting the right type of equipment cannot be taken lightly. In these cases it’s good to have a strong team including polymer specialists and senior design engineers to discuss the selection with. We obviously want to offer a competitive solution, but we will never compromise on safety.”

**ACTORS IN THE GAS INDUSTRY** have to find a balance between equipment cost and performance, and that balance can depend on the particular application. At a gas-sweetening plant, in one position it is perfectly fine to use a gasketed unit – no hydrogen sulphide, moderate temperatures and reasonable pressures. But in another position in the same plant, the conditions could destroy the polymer gaskets. “So we make an assessment,” says Hoffstein. “What is the likelihood of a leak and what are the consequences? If the consequences could be fatal, then we only offer our safest solution, the welded Compabloc, even if the customer claims to want a gasketed heat exchanger.”

In the vast majority of cases, the customer goes for the safer but more expensive solution. “It’s usually a matter of informing and educating,” says Hoffstein. “The safety awareness throughout the gas business is so high so it’s fairly easy to get everyone aligned towards reducing risk.”

Following its acquisition of Aalborg Industries, Alfa Laval is also a major supplier to the natural gas industry of inert gas systems, which play an important role in safety and are required by law on LNG tankers and elsewhere. “We rely on inert gas systems a lot,” says Arnold. “We start out with equipment that is full of air and we want it to be full of hydrocarbons. If we replace the air directly with hydrocarbons, there is a risk of explosion. In these big complex facilities almost universally we displace the air with inert gas first, and then displace the inert gas with hydrocarbons, so that we never have a mixture of air and hydrocarbons.”

New safety challenges are being thrown up by the fact that gas is being produced in ever-deeper water. “It’s always harder to control something you can’t see,” says Arnold. “Flow assurance and keeping things from plugging or corroding are



**THE COMBUSTION TRIANGLE: Three things are required in the correct combination for natural gas to explode: oxygen, heat and fuel. Alfa Laval Aalborg inert gas systems reduce the risk of explosion on LNG vessels during sea transport, unloading and tank cleaning by lowering the oxygen content in the tanks.**



## Controlling risks through design

**INSTALLATIONS SUCH AS PRODUCTION PLATFORMS** and floating production, storage and offloading (FPSO) vessels are a fundamental part of the offshore oil and gas industry's infrastructure. When Aker Solutions designs such complex installations, health, safety and environment are designed in at every step. "Our main goal is to make sure that we can deliver solutions and products that are safe for our clients to operate," says Jan Erik Aspunvik, Health, Safety and Environment (HSE) adviser at Aker Solutions. "We set out to identify the risks, and through our design to control those risks and reduce the probability of unwanted events happening."

**SO AKER SOLUTIONS** designs three major safety principles into its installations. Initially it is important to ensure that gas leakage and fire do not occur. "For example we try to minimize the potential leakage points, such as valves or flanges," says Aspunvik. "Fundamental to safety is having a simple design."

**SECONDLY**, if a leak does occur, systems are put in place to mitigate that event. "If it is not possible to prevent a leakage, we try to control it and reduce its consequences," says Aspunvik. "That can involve taking away the hydrocarbons in a controlled manner, or using firewater systems and gas detection systems."

**THE THIRD SAFETY DESIGN** principle comes into effect if, for whatever reason, the situation gets out of control. "We make sure that we can safeguard the people onboard by evacuating them to a safe haven by helicopter or lifeboats."

To be able to deliver the safest possible solutions to its clients, Aker Solutions

demands the highest standards from its suppliers. "We are relying on their reliability and performance," says Aspunvik. "This is an important part of risk management – that our suppliers comply with our HSE requirements and that the requirements are brought forward to their sub-suppliers."

**ALFA LAVAL** is one of those suppliers, providing Aker Solutions with a range of equipment including high-speed separators and several types of heat exchanger. "Heat exchangers are used to take out or introduce heat to the hydrocarbon stream, and it is important that the system is not subject to any leakage or corrosion that could create an explosive atmosphere," says Aspunvik. "Alfa Laval is in general a company known to deliver high-quality equipment that meets HSE requirements, and this is very important to be a supplier in the oil and gas industry."



**Aker Solutions designs three safety principles into its installations.**

much more complex in deep water than they were in shallow water. And of course now we are producing from gas wells 120 kilometres from shore and that creates a whole new bunch of problems."

**THE ADVENT OF FLOATING LIQUEFIED NATURAL GAS (FLNG)** facilities presents others. "We have experience of LNG tankers, which are quite safe," says Arnold. "But what is different about FLNG is that you have ignition sources sitting above the LNG tanks. This is receiving a lot of concentrated thought and risk analysis."

Arnold says that safety in gas production has improved greatly during his long career, but more remains to be done, especially on building a safety culture in the industry. "There has been a huge change," he says. "For periods of time we make incremental changes, and then something bad happens like Piper Alpha or Macondo [in the Gulf of Mexico in 2010], and all of a sudden we wake up and say, 'Wait a minute, we have to do better than this.' And we make a step change. And then after the step change we go along making incremental changes again until the next accident catches us."

"We have done a very good job of dealing with the kinds of accidents that can injure or kill one or two people. But what we are concentrating on now, and trying very hard to improve, is the very rare, very high consequence issues like Macondo or Piper Alpha." ■



# GENTLE SEA **GIANT**

The Triple-E's scale is mind-boggling: it weighs 60,000 tonnes and is 400 metres long – 76 metres longer than the Eiffel Tower lying down. Launched in June, Maersk Line's new vessel is the biggest ship in the world and, paradoxically, one of the greenest. ▶

TEXT: **CARI SIMMONS** PHOTO: **MAERSK LINE**





**A**S WITH MOST GIANTS, the Triple-E cargo ship from Maersk Line doesn't move quickly. The 400-metre-long, 59-metre-wide vessel lumbers along at an unhurried 18 knots, with its cargo packed efficiently into 18,000 containers.

Marine pilots have been training on simulators and port authorities have been working to expand their capabilities to include wide turning circles and enough water depth to receive the biggest ship in the world. "We've been speaking to port authorities so they understand what kind of a ship is coming in," says Michael Heimann, project manager for the Triple-E.

The Triple-E is not only the largest ship in the world, but also one of the greenest on the seas today. It emits three grams per tonne of goods per kilometre, which is

**“Ocean freight is the most energy-efficient way of moving goods. You can't get such economies of scale with trains, trucks or airplanes.”**

JACOB STERLING, HEAD OF ENVIRONMENT & CSR AT MAERSK LINE

much less than the average container ship emissions of 10 to 20 grams.

Jacob Sterling, Head of Environment & CSR at Maersk Line, points out that alternative modes of transport for long distances, such as air freight, are far less environmentally friendly. "Ocean freight is the most energy-efficient way of moving goods. You can't get such economies of scale with trains, trucks or airplanes."

Airfreight emits about 500 grams of CO<sub>2</sub> per tonne of goods. Using rail transport for the Triple-E's 18,000 containers would require the rather unfeasible option of having a 110-kilometre-long train.

Maersk's goal was to make a ship that was 30 percent more energy and cost efficient than its previous ships. A long-term perspective was applied, says Heimann. "We applied the same line of thinking as when investing in, for example, low-voltage light bulbs," he says. "You pay more initially, but get longer lifetime and a lower electrical bill and since fuel prices are unlikely to fall, this approach makes for a better business case."

**ECONOMIES OF SCALE** were applied to the Triple-E: the more containers that fit in, the more efficient the journey. Achieving such a high capacity required some design adjustments. The Triple-E's hull, for example, is

The Triple-E was designed with a wider, U-shaped hull and more bulbous bow to create more carrying capacity. An extra row of containers was added, providing room for an extra 1,500 containers compared with Maersk's previous largest vessel, bringing its total to 18,000 containers.



**SMART TRANSPORT**  
Grams of CO<sub>2</sub> emitted by transporting 1 tonne of goods 1 km with different means of transport.

Source: Maersk

● Triple-E: 3 g



● Rail: 18 g



● Road: 47 g



● Air: 560 g



U-shaped and more spacious than traditional ships to accommodate one extra row of containers.

The engine room was put at the rear of the ship, instead of in the middle, which is the traditional solution. "By doing this, we are able to fit in more containers behind the navigation bridge and in the hull. It might be a little inconvenient, due to a longer passage to the engine room, but it's not what we consider a problem," says Heimann.

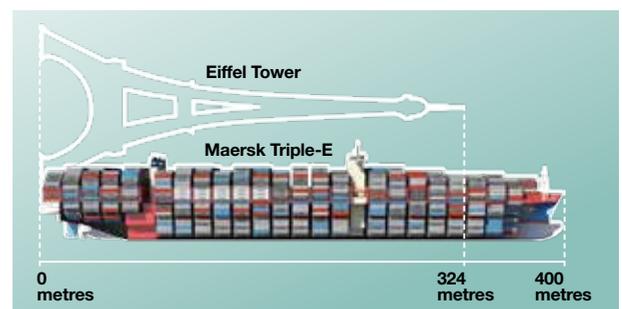
A waste heat recovery system, which uses Alfa Laval boilers, helps propel the ship by capturing energy from the engine's exhaust gas. This cuts fuel by up to 10 percent. The energy is also used to, among other things, produce electricity for the onboard accommodation. The waste heat recovery system has allowed the Triple-E to use a smaller and less energy-consuming main engine. "We put the waste heat recovery system on the Triple-E because we have a good history of adding this kind of equipment to our ships," says Heimann.

**THE TRIPLE-E** has a "twin-skeg" propulsion system with two engines driving two propellers. The ultra long-stroke engines in the twin-skeg configuration operate with a lower number of revolutions compared with a traditional engine. This system will generate further energy savings

of 4 percent compared with a single engine and propeller system.

The new vessels also include Alfa Laval's PureBallast 3.0, which is the latest and most effective version of the water treatment system that uses UV light to protect against the threat of invasive species. Meanwhile Alfa Laval's Aqua freshwater generators use vacuum distillation to convert seawater into high-quality freshwater.

"Since installing these generators, there has never been a lack of freshwater onboard. They're really smart," says Sterling, adding that it's a small investment that brings the crew more comfort in the long weeks and months





spent onboard a ship. “As long as there is water in the ocean we can transform it into freshwater with these generators.”

The Triple-E travels an average speed of 17-18 knots and a maximum 23 knots, compared with the usual 25-knot maximum. Reducing the ship’s speed was a major energy-saving factor. “This significantly reduces the ship’s power requirements,” says Heimann. “With a

reduction of only few knots, we can achieve a dramatic reduction in fuel consumption.”

Sterling says that customers have come to accept the extra delivery time. “They mainly want to know when the goods are coming and whether it takes 25 or 30 days. Customers today realize that we have to do what we can to save energy costs, reduce CO<sub>2</sub> and remain profitable.”

**MANY OF MAERSK’S CUSTOMERS** are big companies with global brands like Nike, BMW and Heineken. They share a strong interest in sustainability and, as Sterling says, “are interested in the results of our efforts”. Maersk promises to continue reducing CO<sub>2</sub> emissions and set strong targets. When Maersk’s five-year-old target to reduce its CO<sub>2</sub> emissions by 25 percent was achieved earlier than expected, it was quickly upped to 40 percent, from 2007 to 2020. “We wanted something to work towards,” says Sterling. “The current focus is on improving fuel efficiency.”

Compared with the industry average, Maersk is already more fuel efficient, emitting 10 percent less CO<sub>2</sub> in 2012 than the competition, which adds up to a total savings of 2.1 million tonnes of CO<sub>2</sub> for all Maersk Line’s customers, adds Sterling.

The Triple-E ships have a life expectancy of 25 to 30 years, but Maersk is already preparing for their future

## TRIPLE-E

Economies of scale, Energy efficient, Environmentally improved

**Weight:** nearly 60,000 tonnes

**Length:** 400 metres

**Width:** 59 metres

**Height:** 73 metres

**Capacity:** 18,000 TEU 20-foot containers

**Top speed:** 23 knots

**Materials:** 98 percent steel

**Travel routes:** Between Asia and Europe plus routes to West Africa

**Expected lifetime:** 25–30 years

**Total number of Triple-E ships to be launched in coming two years:** 20

**Cargo:** Everything from furniture to clothing, electronics and toys

**Length of time to build:** 375 days

**Shipyard:** Daewoo Shipbuilding & Marine Engineering (DSME) in South Korea

The Triple-E's bulk creates more resistance in the water than standard designs. But its dual engine is limited to a top speed of 23 knots and can run as low as 80 rpm, so the increased resistance has no significant impact on the Triple-E's overall efficiency. Bottom left: The Triple-E under construction at the DSME shipyard in Okpo, South Korea.



disassembly and recycling with a new “cradle-to-cradle” passport. “By documenting all major materials in the ships, they can be recycled in a better way and we can get a better price for high-quality steel that, like oil, is rising in price,” says Sterling, adding that working with energy efficiency is an ongoing journey for Maersk.

“We are continuously learning about technologies and developments that can make the next project even more efficient and environmentally friendly. It’s amazing how much was achieved on the Triple-E with existing technologies in terms of CO<sub>2</sub> reductions. Imagine when we start using solar, biofuels or other alternative energy sources. With more breakthrough development on the renewable energy side there will be so much more to come.” ■

**“By documenting all major materials in the ships, they can be recycled in a better way and we can get a better price for high-quality steel that, like oil, is rising in price.”**

JACOB STERLING, HEAD OF ENVIRONMENT & CSR AT MAERSK LINE

## Setting sail for sustainability

Alfa Laval technology plays an important role in Maersk’s ambitious environmental goals for the world’s largest ship.

### ■ Alfa Laval Aalborg waste heat recovery: Reducing fuel consumption

**TRIPLE-E FEATURES** a total of six waste heat recovery systems from Alfa Laval Aalborg, which help reduce the vessel’s fuel consumption by up to 10 percent. Four Aalborg XW-TG units, installed after the main engines, recover the energy contained in waste heat from the engines and use it to superheat steam for use in a steam turbine. This produces additional energy for propulsion and/or electricity for services onboard, thereby reducing load on the engines.

Two Aalborg XS-7TCA waste heat recovery units are used with the auxiliary engines. They utilize the heat in the exhaust gas from the auxiliary engines during port stays, which will significantly reduce the oil consumption for the oil-fired boiler. In addition, Triple-E also features an Alfa Laval Aalborg OS oil-fired steam boiler.

### ■ Alfa Laval PureBallast 3.0: Stopping the spread of invasive species

**TRIPLE-E IS ONE OF THE FIRST** vessels to be equipped with the latest version of Alfa Laval’s chemical-free system for ballast water treatment. PureBallast 3.0 is the new and greatly improved version of a technology launched in 2006 as the world’s first commercially available ballast water treatment system.

The system uses UV light to protect against the threat of invasive species being spread around the globe in ships’ ballast water. Bacteria, microbes and small invertebrates such as jellyfish taken up in ballast water in one part of the ocean, and discharged in another in which they are not native, cause ecological, economic and health problems.

Unveiled in April 2013, PureBallast 3.0 features a new reactor design. It is 50 percent smaller than its predecessor and uses up to 60 percent less energy, while achieving huge improvements in flexibility and flow capacity.

### ■ Alfa Laval AQUA: Turning saltwater into freshwater

**THE FRESHWATER NEEDS** of Triple-E and its crew are met by Alfa Laval AQUA freshwater generators. AQUA uses vacuum distillation to convert seawater into high-quality freshwater for domestic and process utilization onboard.

By providing a constant supply of low-salinity water and continuously controlling the water quality, AQUA eliminates the need for carrying bunker water. Compared with other freshwater generators, Alfa Laval’s solution requires only half the seawater, which means smaller seawater pumps can be used. The reduction in seawater pumping needs has a corresponding effect on the consumption of electrical energy. Less fuel has to be burned, which reduces both operating costs and CO<sub>2</sub> emissions.

The use of corrosion- and erosion-resistant titanium plates, combined with process that inhibits scaling, ensures that AQUA needs little maintenance and will last the lifetime of the ship.

## DECANTER TECHNOLOGY

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# A new spin on South African wine

When one of South Africa's largest wineries invested in Alfa Laval's decanter technology, its intention was to increase capacity during the peak grape-harvesting season. But the cellar's winemakers were surprised to discover that the Foodec decanters have actually led to a significant improvement in quality and energy efficiency as well. Edo Heyns reports from South Africa.

TEXT: **EDO HEYNS** PHOTO: **EDO HEYNS & MATTON IMAGES** ILLUSTRATION: **PETTER LÖNEGÅRD**

**K** **KNOWN FOR ITS FRIENDLY PEOPLE**, rugged landscapes and world famous seasonal veld flowers, South Africa's West Coast wine route is cooled by the Atlantic Ocean and centred on the mighty Olifants River, which is the vein of life for surrounding agricultural activities. The wine industry is the most important source of employment in this region and plays a vital role in uplifting communities by creating job opportunities for unskilled labourers.

The fertile soils and irrigation from the river allow for higher yields of quality grapes and the region has gained a reputation for producing wines that over-deliver at modest prices. Colombar and Chenin Blanc are the most popular grape varieties and produce refreshing, crisp and fruity wines, which are often enjoyed with the delicious lobster and snoek – a sought-after indigenous game fish – that abound in the neighbouring Atlantic.

**NAMAQUA WINES** is the largest and most acclaimed winery in this region, and the second-largest cellar in South Africa. Best known for its cheerful bag-in-box wines, versatile Namaqua also boasts the most acclaimed Pinotage vineyard in South Africa. So it comes as no surprise that domestic demand for Namaqua's wines has steadily increased. To add to this, Namaqua's production manager, Len Knoetze, explains that with smaller wine harvests across Europe, the prices for entry-level white



**Namaqua has installed the world's most expansive wine centrifugal decanter system, with four large Alfa Laval Foodec decanters.**

and red wine in the global bulk wine market had increased phenomenally, which has made this a lucrative sales channel to pursue. Meanwhile at Namaqua, new vineyard plantings and improved farming practices have also led to bigger grape harvests, requiring expansion of the production facility to be able to reduce the pressure on the cellar.

# DECANTER TECHNOLOGY

**BEST CELLAR:** Len Knoetze, left, and Reinier van Greunen say that Alfa Laval's decanter technology has "fundamentally changed" winemaking at Namaqua.



Namaqua's production operations comprise two facilities: Spruitdrift Cellar, where the production of most of the red wines, including the lauded Pinotage, takes place, as well as Vredendal, predominantly a white wine cellar. Because of this cellar's location, expansion is particularly difficult and expensive.

An increase in white grapes intake, however, meant that truckloads of Chenin Blanc and Colombar often had to queue outside the Vredendal facilities before they could be delivered to the cellar. This was not only a frustration to grape producers, but it also had a negative impact on the quality of the grapes and eventually the wines.

"We had to make a decision based on projected growth expectations and the most practical solution was to shift at least 10,000 tonnes of Vredendal cellar's white wine production to Spruitdrift. This had to be done in the most cost-effective manner, that did not require a lot of space – without compromising quality," explains Knoetze.

**THE FIRST DECISION TO BE MADE** was whether to expand by replicating existing processing systems, which comprise pneumatic wine presses and settling tanks. The lucrative

alternative was a continuous centrifugal decanter system, which potentially had revolutionary capabilities, but also involved risk, since no one at Namaqua had experience of this new technology.

This was considered a long-term project, requiring planning and research. "We have a saying that getting married is more complex than buying bread. The expansion process reminds me of that and was almost as crucial as choosing the right wife," jokes Knoetze in typical West Coast fashion.

The first step in choosing "Namaqua's wife" was a trip to Spain, France, Italy and Germany with Alfa Laval business unit manager Ulrik Brasen, during which Len and winemaker Reinier van Greunen had the opportunity to see how Foodec decanter technology was applied in other winemaking regions.

This technology has been utilized by a plethora of food categories, from vegetable oil to beer, but also in the mining and pharmaceutical industries, with recent fine-tuning making it suitable for wine processing. The process effectively replaces conventional pressing and settling with one continuous process. The decanter separates solids from liquid phases in a single continuous



**“ We have a saying that getting married is more complex than buying bread. The expansion process reminds me of that and was almost as crucial as choosing the right wife.”**

LEN KNOETZE, NAMAQUA'S PRODUCTION MANAGER

process, using centrifugal forces. When subjected to such forces, the denser solid particles shift outwards against the rotating bowl wall and the liquid phase forms a concentric inner layer. In winemaking terms, the solid particles would be grape skins and pips, while the liquid component that is extracted would be grape juice that would then be fermented in steel tanks.

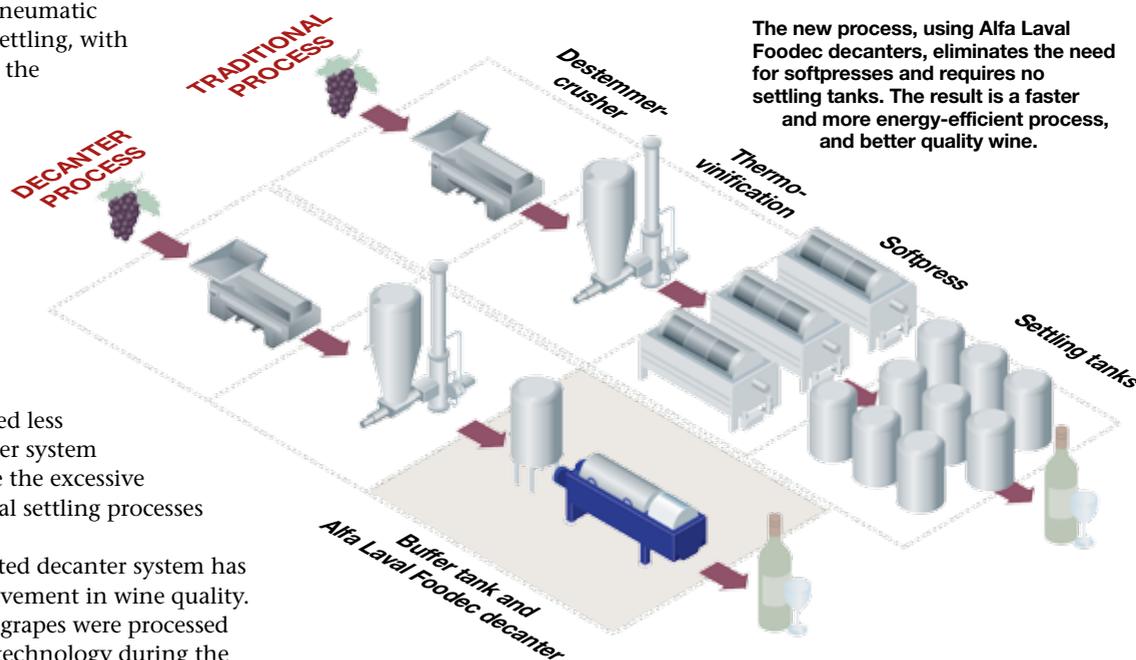
Namaqua did a trial with a decanter in 2011 and was convinced that this new technology could be the best-suited solution to its expansion efforts. The trial was more than enough to convince the Namaqua team that decanters are the progressive way forward. In fact, it led to the installation of the world's most expansive wine centrifugal decanter system, comprising four large decanters, in that same year.

**THE NAMAQUA WINEMAKING TEAM** have not looked back since then and have improved the winery's efficiency by saving time and substituting outdated methods and equipment. Substituting static pneumatic pressing, and particularly juice settling, with one continuous process reduced the processing time from when the grapes enter the cellar door to when the juice is settled in tanks by as much as 24 hours. Similarly, because one continuous process replaces three different conventional steps – free flow separation, pressing and settling – the new system was far less labour-intensive and also required less space. To add to this, the decanter system is more energy-efficient, because the excessive cooling required for conventional settling processes is cut out of the system.

The installation of an integrated decanter system has also led to an unexpected improvement in wine quality. A total of 35,000 tonnes of winegrapes were processed using Namaqua's new decanter technology during the

2012 and 2013 vintage. Chemical analyses and sensory grading through controlled blind tastings revealed that despite the higher juice recovery, grapes that were processed at the new facilities more often than not yielded better-quality wines than those that had undergone conventional methods. This included red, white and rosé wines from different cultivars.

**KNOETZE AND VAN GREUNEN ARE CONVINCED** that the Alfa Laval centrifugal decanting technology has fundamentally changed winemaking at Namaqua and suggested that this would certainly be incorporated in future expansion at the cellars. The tasting panel commented that the 2013 vintage of Namaqua popular white table wines are well balanced, with more expressive fruit character – ideal for Atlantic crayfish and snoek and likely to further increase the demand for these bag-in-box beauties. ■





Former marine engineer **Derek Clark** was alarmed by the oil wastage at his new job in the rail industry. So working in his own time and with his experience of using **Alfa Laval separators** at sea, he came up with an award-winning oil-recycling solution that reduces waste and environmental impact – and **saves lots of money** for his employer.

TEXT: DAVID WILES PHOTO: SAM LEE

**D**URING HIS 16-YEAR CAREER on the Seven Seas with the British merchant navy, Alfa Laval separators were a part of Derek Clark's everyday life. Indeed, the separator has been a fixture of ship's engine rooms for almost a century, cleaning impurities from bunker fuel oil and keeping lube oil free of water. "Bunker oil is pretty much what's left when you've taken all the good stuff out of crude oil and it needs cleaning up, and you can't change your lube oil at sea so you have to get as much life out of it as possible," says Clark, "So that is why we used separators at sea."

But when Clark got a job in the rail industry, as a modification engineer at the main maintenance depot of logistics giant DB Schenker Rail UK in Nottingham, he noticed a different approach to the way oil was handled. "I looked around and couldn't help but notice how much oil was thrown away," he says.

Driven by DB Schenker Rail UK's environmental concerns and its drive to reduce costs, Clark realized that there was the potential to use separators on locomotives much as they are used at sea. His initial idea was to get more life out of the locomotives' lube oil when they came in for service, by cleaning it and reusing it, rather than replacing it with new oil and selling it on cheaply as waste.

But while Clark could clearly see the problem and what could be done about it, there was a small issue: none of this

was actually his responsibility. "To be honest, it really wasn't my job to do this, and I really didn't have time to work on it anyway," he says. "But I was troubled by the fact that we were throwing all this oil away." So working on his own initiative and his own time, at weekends and after work, Clark started looking into whether separators could be used on locomotives.

"I got the information together, looked at the Alfa Laval website to see what models were available in the size we would need. I checked everything, including the pricing, and put the case to my superiors – who needed some convincing at first."

But realizing that Clark was on to something, DB Schenker Rail UK invested in two Alfa Laval separators, which he modified slightly for the application. "When we actually took delivery of the separators I found out that we had a lot of dirty diesel that we either stored or just burned off," he says. "I thought 'why are we burning it when we could use it again?' I knew that separators could be used for cleaning diesel as well, so that is what we started doing."

**THE COMPANY HAD A LARGE NUMBER** of locomotives in long-term storage on site. Most of them had fuel in their tanks that had to be drained. Because the locomotives had been in storage for some time the fuel had become damp, due to condensation in the tank, and in some cases this had led to microbial contamination. So these locomotives were drained into a spare storage tank and the excess water removed, and then an Alfa Laval Oil

OIL CLEANING  
MODUL 103

**SEA CHANGE:** Standard equipment in the marine industry, the Alfa Laval Oil Cleaning Module has proven to be equally effective for rail applications. It is used to clean lube oil and diesel oil, creating both financial and environmental benefits for DB Schenker.

**DB SCHENKER** uses Alfa Laval's Oil Cleaning Module (OCM), a skid-mounted system built around a highly efficient Alfa Laval disc stack centrifuge that removes particles and water from oil.

**SEPARATION** takes place in a disc stack centrifuge designed to retain any solids present in the oil. The feed pump moves the contaminated oil into the centrifuge where centrifugal force separates the feed flow into its different phases.

**THE HEAVIEST** of these phases – sludge and water – are forced to the periphery of the bowl. The sludge component is deposited in the sludge space for removal at regular intervals. The clean oil and the separated water are discharged on a continuous basis.

Cleaning Module (OCM) was attached to the lower drain point and the tank was circulated for a week. After a week a sample was sent away to be tested for particle count, water content and microbe contamination. In all cases one week was enough to get the counts down to a satisfactory level. A biocide was added to the tank for extra protection.

Such were the savings that resulted that DB Schenker Rail UK's initial investment cost was paid back within months. "We had had quite a lot of locos to be emptied, so payback only took three or four months," says Clark. "So that has paid off the cost of the separators, plus turned a profit. We have fewer locos coming into the stable now, but we still get some locomotives coming in with microbial contamination that have to be drained, so the savings are ongoing."

Besides the money savings, there are environmental benefits of using separators to clean oil. "We don't have lorries coming in and out to empty out the tanks," says Clark. "Plus we don't burn the waste oil anymore, which is an inefficient way of using the boilers and a very inefficient way of getting rid of the oil."

**CLEANING THE LUBE** oil of contaminants that abrade metal surfaces and increase friction can also increase engine life. "Some of the engines we have get very dirty very quickly – it is mainly carbon that builds up," says Clark. "The last time I cleaned one I got half a kilogram of solid material over two days. When you show a lump like that to the managers, they get pretty interested."

Needless to say Clark's bosses are delighted with the money savings and the environmental improvements that resulted from his idea. They nominated him for – and he subsequently won – the Railfreight Engineer of the Future Award at the 2011 Rail Business Awards for "delivering pioneering locomotive fuel-saving initiatives." But he is modest about his award, pointing out that this technique was actually used in the rail industry decades ago, but subsequently forgotten.

The idea has also generated considerable interest in the

**“ We had had quite a lot of locos to be emptied, so payback only took three or four months.”**

DEREK CLARK

wider UK rail industry. "Since I won the award I have had people emailing me and calling me to find out more," says Clark. "But there is a lot of inertia to go against."

**SO DOES HE THINK THAT THE COST SAVINGS** involved might help overcome that inertia? "Yes," says Clark. "We should be able to get more use out of our oil. In the rail industry they have tended to throw stuff away, whereas in the merchant navy you can't do that; you have to use what you've got. That is what I was aiming to do here. The attitude in the industry at the moment is that they don't see the far end of the system, they just see the front end."

Clark is now investigating other applications for separators on locomotives, such as using Alfa Laval's smaller Eliminator Filter fitted permanently to the engines to filter, automatically backflush and centrifuge the oil while the loco is in operation, as opposed to just when it comes in for a service. "Hopefully that will keep the solid level down dramatically," he says. "And I think that will really impress people."

**SO WHILE USED OIL** was once treated as waste and either burned or otherwise disposed of, Clark's bright idea means that less oil has to be bought in the first place and that oil that is bought goes further. Should it be taken up as a standard operating procedure in the rail industry in the UK – not to mention beyond – the savings would be considerable. "If the rail industry was cleaning engine oil in a similar way to the way it is done at sea, then you could extend the life of the oil by about 50 percent with associated cost savings," says Clark. "And then further up the line you get rid of dirty oil and the pollution that it generates. Using separators just makes good sense, really." ■

## The height of sustainability

**THE LAST BEAM** has been put in place, and Shanghai Tower is now officially the world's second-tallest building. But its architects and owners didn't just set out to go high – they also wanted to go green.

So this 632-metre-tall “green vertical city” will get heating and cooling from geothermal energy sources, while supplementary electricity will come from vertical-axis wind turbines located near the top of the tower. The double-layered insulating glass façade is intended to reduce the need for indoor air conditioning, and is composed of an advanced reinforced glass with a high tolerance for shifts in temperature.

About a quarter less structural steel than a conventional design of a similar height was used in its construction, while more than 30 percent of the site will be green space and landscaping to breathe fresh air into Shanghai and help keep the tower cool.

Alfa Laval was selected to contribute solutions to Shanghai Tower's sustainability goals, supplying more than 40 cooling units from its energy-efficient T-series and M-series plate heat exchanger lines. Six different models will be used in a range of processes in the building.

Alfa Laval has worked in close cooperation with tower designers and engineers since it was chosen to supply the plate heat exchangers for heating, ventilation and air conditioning.

The 121-storey Shanghai Tower will be completed in 2014, standing as the tallest of a “harmonious skyscraper community” alongside the 420-metre-high Jinmao Tower and the 492-metre-high World Financial Center in the Lujiazui Finance & Trade Zone.





**ALFA LAVAL T35/TS35**

- The Alfa Laval T35/TS35 gasketed heat exchanger has been developed for a broad range of applications, from basic water-to-water duties to tough applications with high temperatures, aggressive media and high pressures.
- It is the ideal choice as a closed-loop cooler, utility or process heat exchanger in industries including marine, nuclear power, conventional power, renewable/clean power, steel, mineral processing, petrochemicals, ethanol, sugar and fertilizers.
- It offers many advantages, including low maintenance costs, energy savings due to minimum fouling, low investment costs, easily expandable capacity and maximum operational reliability.
- It features several innovations to reduce maintenance costs, maximize heat transfer and increase uptime, including CurveFlow heat transfer plates, ClipGrip gaskets, and the Five Point Alignment System.

## Productivity up – costs down

Featuring innovations that minimize maintenance costs and maximize uptime, the all-new Alfa Laval T35/TS35 demonstrates Alfa Laval's leadership in heat exchanger technology across a wide range of industries.

**ALFA LAVAL'S LATEST** gasketed heat exchanger, the T35/TS35, revolutionizes cooling systems on land and at sea. A wide selection of plate and gasket materials makes the T35/TS35 ideal for use in basic water-to-water duties, in applications with high temperatures, and with aggressive media and high pressures. It provides benefits for customers in nuclear and conventional energy, chemical production, steel and mineral processing, and marine applications.

This next-generation heat exchanger features a number of innovations, including a new and patented CurveFlow distribution area that gives the T35/TS35 a much more uniform flow distribution than other plate heat exchangers. This

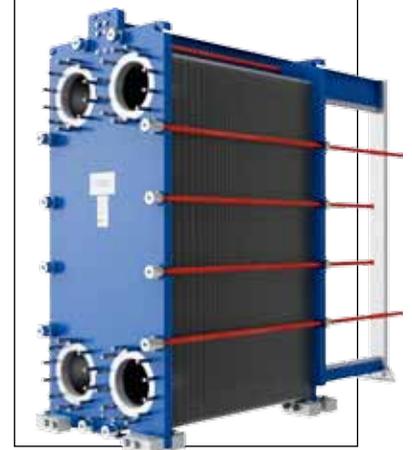
means there are no stagnant zones and significantly less fouling. The uniform flow also improves thermal efficiency. What this means for customers is low maintenance costs, energy savings, compact installations and high performance.

**ANOTHER NEW FEATURE** on the T35/TS35 is Alfa Laval's new ClipGrip gaskets, which offer totally glue-free mounting and are designed for maximum lifetime, high reliability and simple maintenance. The attachments grip the plates from both sides to keep the gaskets firmly in position. ClipGrip gaskets minimize problems with gaskets creeping out of their grooves, plate pack misalignment and leaks.

"The CurveFlow distribution area and ClipGrip gaskets help cut maintenance costs and improve uptime," says Erland Elwin, portfolio manager GPHE, Process Industry at Alfa Laval. "These innovations once again demonstrate Alfa Laval's technical leadership in heat exchanger technology."

**ADRIAN HOGAN**, business manager Marine Plate Heat Exchangers, highlights the T35/TS35's benefits for marine applications. "Shipowners consider performance, reliability and lifecycle costs as critical factors when selecting new heat exchangers for their vessels," he says. "However, the single most important factor for decision-makers is the investment cost."

The T35/TS35 gives the lowest total costs over the lifecycle of the heat exchanger. "The T35 is engineered for cost-effectiveness and provides higher heat-transfer efficiency, more uptime and reduced installation, operation and maintenance costs," says Hogan. ■



# CHINA'S BROWN GOLD

Used in Chinese cuisine for more than 2,000 years, soy sauce is today still made according to a time-honoured process. But in the space of just four years, many leading soy sauce producers in China have started to scrap traditional methods and switch to modern equipment from Alfa Laval. The result has been more efficient production, and improved product quality.

TEXT: JAN HÖKERBERG PHOTO: RINGO HO, WANG JING





Fermentation tanks at Guangdong Meiweixian Flavouring Foods factory. This step of the manufacturing process can take up to six months.



Meiweixian's Chubang soy sauce is one of China's biggest-selling brands, one of perhaps 1,000 brands in the country.



**T**HE MILD SCENT of soy sauce hangs in the air outside Guangdong Meiweixian Flavouring Foods factory in the southern Chinese city of Zhongshan, reminding the visitor that this is the soy sauce capital of the world.

Meiweixian, with its Chubang brand, is one of the leading producers of this liquid seasoning, which is made from a fermented paste of boiled soybeans, wheat, brine and a mould. Soy sauce was originally invented in China sometime around the 5th century BC, and with its deep brown colour, pleasant aroma and richly satisfying flavour, it is used in place of salt in East and Southeast Asian cuisines, both for cooking and as a condiment. It is also increasingly seen on dining tables in the Western world.

"Meiweixian is number two in the market in China, but the top 10 producers only hold about 20 percent of the market – so there is a great growth potential in this category," says general manager Yang Mingquan, who is also in charge of production technology at Meiweixian. The company has grand expansion plans to almost double the production in Zhongshan to 500,000 tonnes within three years while building a new factory in Yangxi,

also in Guangdong, which will have a capacity of 1 million tonnes.

This Pearl River Delta region in southern China has played a major role in the country's rapid industrialization over the past two decades, but it is also a centre for the very traditional soy sauce industry. Most of the country's leading soy sauce producers have clustered in Guangdong because the province's weather conditions are best for fermentation, which is a critical step in the manufacturing process.

**CHINA IS THE** world's leading soy sauce producing country with an annual production of approximately 5 million tonnes – more than half of the world's total production of 8 million tonnes. The domestic soy sauce market is highly fragmented, with several hundred – perhaps as many as a thousand – producers. The government is pushing the soy sauce industry towards consolidation, so it is expected that many of the small and medium-sized producers will either go out of business or be acquired.

While many other industries in China have modernized through the introduction of advanced equipment, soy



Meiweixian plans to almost double production in Zhongshan to 500,000 tonnes within three years. A new factory being planned in Yangxi will have a capacity of 1 million tonnes of soy sauce.

### Did you know?

■ Soy sauce originated in China around the 5th century BC

■ The moulds *Aspergillus oryzae* and *Aspergillus sojae* are important ingredients

■ Taiwan, Japan, Korea, Vietnam, Burma, Indonesia and Brazil have their own varieties of soy sauce

■ Chinese dark soy sauce contains 10 times the antioxidants of red wine and is also rich in lactic acid bacteria

■ Soy sauce is mildly alcoholic

■ Glutamic acid gives soy sauce its flavor-enhancing properties



sauce production in China remains very traditional and labour-intensive. For example, after fermentation – which can take up to six months – the sauce needs to be filtered, but the filtration process is still carried out by hand, which can pose food hygiene problems.

Four years ago Alfa Laval realized that its high-speed separators, sterilizers and evaporators – which are used extensively for wine, tea, coffee, juice and dairy production around the world – could modernize this ancient industry. As with these other foodstuffs, there was potential for soy sauce to be made in a more cost-efficient way, and for product quality to be improved.

**A TEAM LED BY** Daniel Lin at Alfa Laval in Shanghai contacted leading soy sauce producers to spread the word about the benefits of introducing high-speed separators to soy sauce production. There was initially some resistance, as the soy sauce industry is highly traditional. Also, the technology had not been tested commercially for soy sauce applications, and Alfa Laval – despite being a world leader in the food and beverage industry – was largely unknown in the Chinese soy sauce business. So field tests were carried out with a small separator at a number of



“Our products are regarded as high-quality, so we need to have a high standard of equipment in our factory.”

YANG MINGQUAN, GENERAL MANAGER

potential customers’ sites. Due to differences in raw materials and fermentation processes, soy sauce varies from customer to customer, so Alfa Laval carried out extensive testing to come up with tailor-made solutions for each customer.

Tests showed that Alfa Laval separators offer significant savings in manpower; with traditional soy sauce production between three and five people are needed per machine in the process. With Alfa Laval separators, one



The Alfa Laval separator at the plant offers significant savings in manpower, requires less space, and leads to a higher-quality end product than traditional solutions.

separators for wine, tea and juice, but it would not work for soy sauce since the separators and sterilizers would corrode in just a few months.

“Soy sauce is a very special product,” says Lin. “The low pH value – about 4.5 to 5.5 – combined with high temperatures and a high salt content – 18 to 22 percent – make the working conditions for the machines very tough.” So material specialists at Alfa Laval’s Materials & Chemistry Centre in Sweden tested different varieties of soy sauce supplied by Chinese manufacturers with many different materials, and came up with innovative solutions. So now the AlfaVap evaporators for soy sauce feature titanium plates, while the separators are made with specially developed anti-corrosion materials.

**MEIWEIXIAN BECAME AN** Alfa Laval customer in August 2012, when it took delivery of the first high-speed separator at its factory in Zhongshan, and followed this up a year later with an order for AlfaVap. “Our products are regarded as high-quality, and that is why we need to have a high standard of equipment in our factory,” says Yang. “We are still testing, but we believe that the separator can substantially improve our products, especially within the filtration area. Traditional filtration with sediment tanks leaves a lot of sludge.”

Word has spread quickly about the benefits brought by Alfa Laval equipment among China’s main soy sauce producers. By June 2013, seven of the top 10 soy sauce producers in China were using Alfa Laval technology. Besides Meiweixian, customers today include Foshan Haitian, Lee Kum Kee, Yantai Shinho, Nestlé Maggi, Heinz Foodstar, Hengshun, and Pearl River Bridge. “In just four years, our soy sauce equipment business has grown substantially,” says Lin.

The experience of the Chinese soy sauce industry and its switch to Alfa Laval solutions shows that even with processes that have been tweaked and refined for many centuries, there is always room for improvement. ■

worker can supervise up to four machines. The Alfa Laval equipment also takes less space in the factory, reduces the processing time, and is easier to clean than existing equipment.

And then there are considerable product quality benefits from the Alfa Laval technology: contamination risks are reduced as Alfa Laval separators meet stringent food hygiene standards, unlike the existing equipment used by soy sauce manufacturers, which is often not designed specifically for food use.

**FOR DARK SOY SAUCE**, which is thicker, richer and has caramel added, manufacturers need to reduce the water content, and the traditional way to do this is to use a boiling tank. Alfa Laval’s solution for this is an evaporator called the AlfaVap. This streamlines the process and makes it considerably more energy-efficient: 60 percent of the energy can be saved compared with traditional production.

One early challenge Alfa Laval had to overcome in adapting its technology for soy sauce production was finding the right material for its equipment. Normally, stainless steel is used to manufacture the high-speed

## GUANGDONG MEIWEIXIAN FLAVOURING FOODS

**Established:** The original company started production more than a century ago. Factory production started in 1956. Owned by the state-owned enterprise Jonjee Hi-Tech Group.

**Location:** Zhongshan, Guangdong province, China.

**Annual turnover:** About 2 billion yuan (EUR 24 million).

**Leading brand:** Chubang.

**Current production volume:** 300,000 tonnes in 2012 at the Zhongshan plant. Soy sauce represents 75 percent of production. Planned expansion to 500,000 tonnes in 2015. The company has also invested in another site at Yangxi, with a planned production volume of 1 million tonnes, of which some 200,000 tonnes will consist of canned snack food.

**Number of employees:** 2,000.

**Products:** Soy sauce, oyster sauce, chicken powder, preserved bean curd, vinegar and various types of seasoning sauces and powder, in total nine categories.





# COOL SOLUTION TO A HOT ISSUE

Ever-increasing use of the internet means servers in data centres are generating ever-increasing amounts of heat. A British start-up has come up with an ice-cool solution – incorporating Alfa Laval equipment – that reduces cooling bills and associated CO<sub>2</sub> emissions by more than 90 percent. ▶

TEXT: **DAVID WILES** PHOTO: **ISTOCKPHOTO & ICEOTOPE**

Worldwide CO<sub>2</sub> emissions could be reduced by about 1 percent if all data centres switched to Iceotope technology, according to the company's estimates.

**E**VERY TIME YOU CLICK “like” on Facebook or do a search on Google, a server located among rows and rows of machines in a data centre somewhere in the world processes a response. Google has an estimated 2 million servers worldwide, Amazon about 450,000 and Facebook in excess of 200,000, and this rapidly growing battery of equipment handles huge amounts of data, in the process generating huge amounts of heat.

These data centres consume phenomenal amounts of energy for cooling – as much as a couple of percent of the world’s electricity, by some estimates. That means massive energy bills – in the United States alone, USD 6 billion is spent each year cooling data centres – and vast amounts of carbon dioxide emissions. With the server industry growing by about 12 percent per year, those energy demands will only increase. In response, some IT companies are establishing their data centres above the Arctic Circle to take advantage of the free natural cooling the location provides.

But a start-up based in Sheffield, UK, has developed an innovative solution that allows servers to be cooled cheaply and efficiently, wherever they are in the world. Iceotope’s innovation is being regarded as one of the most exciting cooling solutions for data centres, and one that could revolutionize the industry. And Alfa Laval heat exchangers play a key role in the system.

**ICEOTOPE’S SOLUTION IS** based on the same basic idea that has you running your hand under cold water when you burn yourself, rather than blowing on it: Namely, that water is a better conductor of heat than air. In fact, water is 1,850 times more effective at cooling than air.

“What we are trying to do is eradicate waste from the data centre,” says Peter Hopton, Iceotope’s founder and CEO. “We see waste as more than one thing. We see it as wasteful infrastructure that isn’t really needed, and as wasteful power consumption. It is our mission to rethink the data centre and eliminate waste by using liquid cooling technologies.”

The current status quo sees data centre servers cooled

by cold air that is blown over the hot components. But this is noisy and inefficient, and it involves lots of equipment that could be eliminated by liquid cooling. “Usually at a data centre, half of the total power consumption comes from fans, air conditioning and air handling, and that is wasteful,” says Hopton.

**ICEOTOPE’S TECHNOLOGY** essentially eliminates the need for fans inside the servers. “They are replaced by a system that operates on natural convection,” Hopton says. “We eliminate the computer room air cooler (CRAC) units, we eliminate the compressors, and we eliminate the heat pumps. All that we have is circulation pumps circulating coolant out to external radiators. And that pretty much eliminates up to 97 percent of the power that used to be consumed by a typical cooling system.”

Iceotope’s solution has three cooling stages. In the first stage, at the servers, a special ultra-convecting liquid called 3M Novec Engineered Fluid convects heat almost 20 times faster than water could. This remarkable liquid, in which the motherboard blade is completely submerged, does not conduct electricity as water does, but it does take the heat away from the electronics. The electronics are otherwise unaffected by the liquid. In fact, you could throw your smartphone into a tub of it, and it would continue to work perfectly.

In the next stage, the heat taken out of the servers by the liquid is circulated around the cabinet by Alfa Laval heat exchangers located inside the cabinet. In the third stage, the heat exchangers transfer heat from the secondary loop to a third and final water loop that takes the heat out of the building. The system also allows for heat capture, delivering it in the form of hot water for reuse, such as for heating the building.

There are two Alfa Laval heat exchangers in each server cabinet. “They decouple our cabinet from the building, which means that if there is a fault in the cabinet, it only affects that cabinet, and not any other cabinets in the building,” says Hopton. “With a system like this, in order to be scalable you have to have that level of decoupling. If you’ve got thousands of cabinets, the probability of having a faulty one at some point increases, and you will want the fault to stay in one cabinet rather than causing a fault in the entire building.”

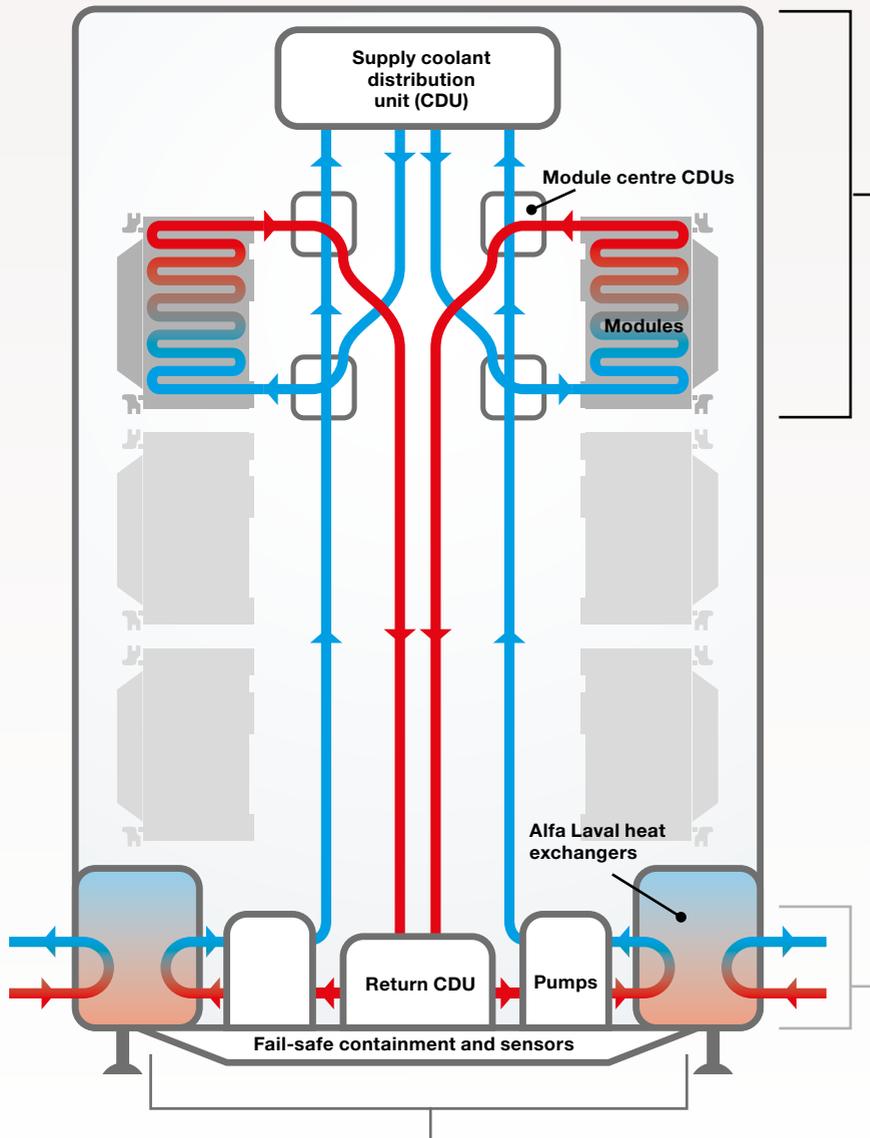
**ICEOTOPE’S SERVER SYSTEM** typically reduces data centre cooling costs by up to 97 percent; server power demands by up to 25 percent (because there are no fans and no moving parts); and overall ICT infrastructure costs by up to 50 percent, compared with traditional air- or water-cooling systems. The system generates water up to 50 degrees Celsius, and that heat can be reused, giving double energy and carbon savings. Because the system is

**“ It is our mission to rethink the data centre and eliminate waste by using liquid cooling technologies.”**

PETER HOPTON,  
ICEOTOPE’S FOUNDER AND CEO



# GO WITH THE FLOW



## Iceotope's solution has three cooling stages

1 3M Novec Engineered Fluid convects heat away from the electronics.



2 The heat is circulated around the cabinet by Alfa Laval heat exchangers.

3 The heat exchangers transfer heat to a final water loop that takes the heat out of the building.

also silent – unlike with noisy traditional air-cooling solutions – servers and supercomputers can operate alongside people, such as in labs.

So this next-generation liquid-cooled technology means that big players in the data centre industry will not be forced to locate their facilities in cold climates. “It makes little difference whether you are operating in the

Arctic Circle or on the south coast of Spain or somewhere in Africa,” says Hopton. “With the Iceotope solution you can site your data centres in locations that are more suitable in terms of other criteria, such as connectivity and power, as opposed to having to worry about ambient conditions. The value of the potential market for this product is in the billions.” ■

# From this... to this

**Under the big skies** of Big Spring, Texas, water is a precious and limited resource. The Lone Star State is drought prone, and clever solutions will be needed if it is to have enough water to meet the needs of its growing population.

While traditional sources of water such as groundwater dwindle, there is one previously untapped source that is becoming part of the solution: wastewater. In Big Spring, sewage water is now being cleaned up for reuse at a new USD 14 million wastewater treatment facility.

The facility is the second plant of its kind in the US, and only the third of its kind in the world. It uses an innovative water treatment process called direct potable reuse – a process by which liquid waste undergoes advanced treatment

processes and is routed directly to the drinking water supply instead of indirectly through lakes and reservoirs.

A key component of the process is an ISO-DISC cloth media filter made by Ashbrook Simon-Hartley, a company acquired in 2012 by Alfa Laval. ISO-DISC is one of three advanced filtration systems at the plant and is used as a pretreatment for membranes – an important part of the overall process. Direct potable reuse shortens the filtration process from weeks or months to hours.

The Big Spring wastewater treatment facility can supply an additional 7.5 million litres of water per day – enough for approximately 10,000 people – at a time when the area's other water sources are nearly depleted.

As access to drinking water becomes a more pressing problem in water-scarce regions everywhere, direct potable reuse is expected to become an increasingly common method for cleaning the water that will quench the world's thirst.



# 50

Alfa Laval Chile & Peru  
is celebrating its 50th  
anniversary in the South  
American market.

## Alfa Laval to open cutting-edge test and training facility

**Alfa Laval** is constructing a new test and training centre in Aalborg, Denmark. It will host testing and related research activities for a range of equipment and solutions, with a special focus on marine and diesel power applications.

Due for inauguration in January 2014, the centre will increase Alfa Laval's research and development capabilities as well as the exhaust gas cleaning system performance validation offered by the company. Tests will be conducted using a large 2MW marine diesel engine under real operating conditions.

"Alfa Laval's investment in the new test and training centre underscores our dedication to further developing our capabilities within the marine industry," says Peter Leifland, president of Alfa



**The 32-metre-high smokestack for the 2MW engine on which tests are conducted arrives at the Danish facility.**

Laval's Marine & Diesel Division. "The test centre will ensure a swift introduction of additional exhaust gas cleaning systems developed specifically for, and with input from, our customers and their specific ship types."

Although the new test and training centre has its main focus on exhaust gas cleaning solutions, it will also support some 16 Alfa Laval product lines – from equipment for ship fuel lines and ballast water treatment, to

solutions for heat exchange and waste heat recovery.

In addition to equipment testing, the new facility will also serve as a training centre to familiarize and train ship owners, operators and crew on the new technology.

# 2.1bn tonnes

The amount of waste generated globally each year. That waste contains about 24.5 quadrillion British thermal units (Btu) of energy – enough heat to generate about 10 percent of the electricity consumed annually around the globe. By 2012 the annual global market for waste-to-energy technologies is expected to exceed \$27 billion.



## Middle East energy-efficiency order

Alfa Laval Aalborg has won an order to supply waste heat recovery systems for two diesel power plants in the Middle East. The order, booked in the Marine & Diesel Equipment segment in early July, has a value of approximately SEK 80 million. Delivery is scheduled for later in 2013.

The Alfa Laval Aalborg waste heat recovery systems will reuse heat from diesel engines to produce steam for the turbines that generate electricity in the diesel power plants. The plants, built by the Danish power plant specialist Burmeister & Wain Scandinavian Contractor A/S (BWSC), will secure reliable and efficient power generation in Lebanon.

## Energy breakthrough for paper industry

In what appears to be an important energy breakthrough for the paper industry, a new application of Alfa Laval spiral heat exchangers (SHE) is showing great promise and could bring about substantial annual cost savings.

Following successful pilot-scale trials on deinked pulp (DIP) at the Mayr-Melnhof paper mill in Eerbeek, the Netherlands, a full-scale unit is now being installed to recover heat from the flue gas of the boilers. Most of the heat is destined for heating pulp.

If the conservative calculations prove correct, the mill could save at least 450kW – or more than EUR 150,000 on its annual steam costs.

Due to its unique viscosity characteristics and

fibre content, pulp higher than 0.2 percent consistency has long been a challenge for heat exchangers. While very dilute pulp slurries of less than 0.2 percent can normally be processed in plate heat exchangers, higher solids have previously been impossible due to plugging.

Hanns Schuster, president of HS Vertretung, which is Alfa Laval's pulp and paper agent in mid-Europe, is excited about the application of SHE for pulp heating in consistencies as high as 5 percent. "I have worked with papermaking for a long time, and traditionally it was thought to be impossible to run over 1 percent consistency pulp in a spiral heat exchanger. This new Alfa Laval design is going to change that."



## An order that will knock your SOx off

Alfa Laval has won a large marine environmental order, worth SEK 170 million from a single customer, to install its PureSOx exhaust gas cleaning systems onboard seagoing vessels.

The systems clean sulphur dioxide (SOx) from ships' exhaust gases, enabling them to meet incoming International Maritime Organization's (IMO) regulations demanding that emission levels in certain Emission Control Areas are cut to 0.1 percent from January 2015.

To reach these levels, ship-owners can either use expensive low-sulphur fuel or, on vessels where it is suitable, continue to run ships on heavy fuel oil and invest in a scrubber such as Alfa Laval PureSOx.

"The order proves that Alfa Laval's scrubber technology is an

attractive solution to ship owners who need to comply with IMO's convention for the reduction of sulphur oxides, be it for retrofits or for installation onboard new vessels," says Lars Renström, President and CEO of the Alfa Laval Group.



# A fresh approach to heat recovery



By the middle of this century our planet's population is expected to grow by 50%. At the same time, standards of living are expected to rise. This leads to increased energy consumption.

Alfa Laval is actively contributing to a more efficient energy use. Heat recovery in oil refineries is a good example. With traditional technology only about 70% of the energy is recovered. Our compact, fully welded heat exchangers enable a recovery of no less than 95%. Today we have several thousand heat exchangers of this type installed around the world. They don't just save energy and money. They also help reduce global carbon dioxide emissions by some 12 million tonnes a year. This equals the emissions from all the cars in Sweden. Talk about putting energy into creating innovative solutions!