NO. 34
AN INTERNATIONAL MAGAZINE FROM ALFA LAVAL

here

ALFA LAVAL
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THE CLEAN WATER CHALLENGE

Can **technology solve** the world's **water** crisis?

PUMP ACTION
How Framo pumps make sunken WWII shipwrecks safe

SLOWLY DOES IT
When it comes to cooling data centres, slow is best

RAYS OF HOPE
Sunshine and seawater make the Australian desert bloom

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Low-speed ventilation represents a paradigm shift in the cooling of data centres.

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Harpoon Brewery succeeded in scaling up production without diminishing quality.

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Coming clean

editorial Never has a corporation's purpose and reputation been more in focus than today. It's not only ethical funds and investors that are influenced by what a company does and what it stands for, but also increasingly customers and employees – current and future.

This means that a company's reason for being is constantly questioned and evaluated. A new dimension in this context is water, or rather how and what a company contributes to providing safe water. One in nine people worldwide lacks access to safe water today, and population growth, urbanization and changing lifestyles mean demand will only increase.

In this edition of *here* we investigate the water issue, which is one of the most pressing challenges facing the planet. But as we report in our theme article, technology can help solve that challenge.

FOR INSTANCE TECHNOLOGY can be used to generate fresh water. We visit Sundrop Farms' pioneering facility on the scrublands of Southern Australia where clean, renewable solar energy generates electricity to heat greenhouses, but also powers an Alfa Laval desalination unit that produces water for the plants growing there.

We can also make more effective use of the water that is available, by cleaning and reusing it. As one of our own water experts points out, even the dirtiest water can be cleaned by existing technologies – the question is just which technology to use.

We report on technologies that protect water from various contaminants, such as Framo's technology safely removing toxic fuel oil from Second World War shipwrecks off the Norwegian coast. And the new and improved version of our ballast water treatment reactor that protects against the one of the biggest threats to biodiversity – invasive species.

ON THE THEME of making things better, you can also read about the

unique solution for creating a comfortable indoor climate at the Lhasa Educational District in Tibet; a new technique for responsibly producing oil in the Amazon; and low-speed ventilation that increases effectiveness in data centre cooling. I promise that you will be inspired.

Enjoy!

PETER TORSTENSSON
SENIOR VICE PRESIDENT,
HEAD OF COMMUNICATIONS
ALFA LAVAL GROUP

Smooth sailing for cruise line with Alfa Laval PureSOx

With Alfa Laval PureSOx scrubbers, RCCL vessels will run on heavy fuel oil and still meet emissions regulations.

Royal Caribbean Cruises Ltd (RCCL) has placed an order for four Alfa Laval PureSOx scrubbers. Using PureSOx, ship owners can continue to operate on heavy fuel oil (HFO), instead of more expensive marine gas oil, and still meet the International Maritime Organization's strict sulphur oxide (SOx) emission regulations. However, space and stability limitations can prove a challenge.

"There is immense complexity in a retrofit of this size aboard a cruise ship," says Kevin Douglas, Vice President, Technical Projects and Newbuild, at RCCL.

"To ensure the right solution and the smoothest possible implementation, we needed a thorough, open and systematic dialogue. Alfa Laval has worked closely and vigorously with us to merge their system knowledge with our expertise in cruise ship installations. As a result, we have confidence the strong partnership will deliver results."

Meanwhile, Alfa Laval has secured a worldwide patent for the technology inside the PureSOx H_2O water-cleaning unit. The unit is completely unaffected by pitch and roll, which sets it apart from other cleaning systems on the market. It has a footprint of just 6 square metres and a modular construction based on three flexibly placed skids.

The patented technology is crucial to secure compliance in either hybrid or closed loop mode, especially in ports in Belgium and Germany, where the use of open loop scrubbers is banned.

INDIA

Popular indian drink gets longer shelf life

Neera is a popular health drink in India made from the sap of immature unopened coconut flowers, known as inflorescence. Rich in sugars, minerals and vitamins, and translucent white in appearance, it is good for the digestion and prevents jaundice.

The traditional production method sees coconut inflorescence tapped for its sap, then filtered, pasteurized, and supplemented with preservatives. Alfa Laval India has now improved on the traditional processing method by developing a modular continuous concept, which gives neera a longer shelf life.

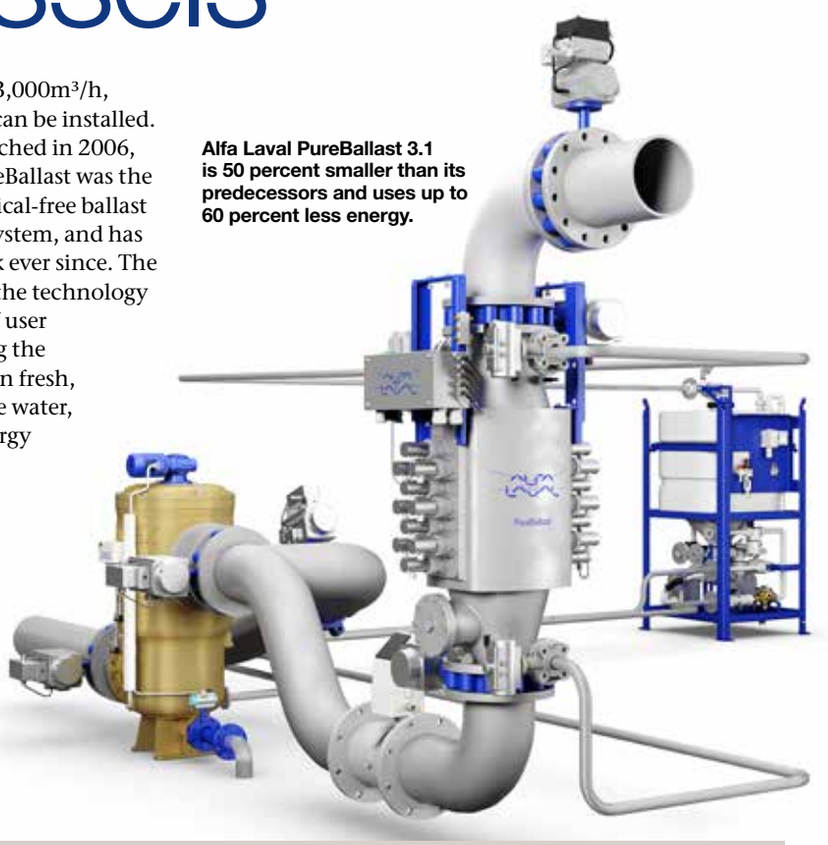
A modular concept skid contains Alfa Laval components including an Alfa Laval Clara 20 separator, plate pasteurizer, pumps valves and fittings, to reduce installation lead times. The Coconut Development Board has approved Alfa Laval's proposals and already placed orders for four projects in Kerala. Now the states of Karnataka and Tamil Nadu have also approved neera processing.

Ballast water treatment now available for smaller vessels

Water moved around the world in ships' ballast tanks can contain countless viruses, bacteria and other biological agents with the potential to cause harm when discharged into new marine habitats. In fact, the introduction of non-native species is one of the biggest threats to marine biodiversity.

To help combat the threat of invasive species from ballast water, Alfa Laval has introduced PureBallast 3.1 – a new and improved version of its industry-leading ballast water treatment reactor. Now even smaller and more compact than before, Alfa Laval PureBallast 3.1 can be used in systems as small as 32m³/hour, making it ideal for smaller vessels, and up to 3,000m³ per hour. For flows in excess of 3,000m³/h, multiple systems can be installed.

When first launched in 2006, the Alfa Laval PureBallast was the world's first chemical-free ballast water treatment system, and has set the benchmark ever since. The latest iteration of the technology offers a number of user benefits, including the ability to operate in fresh, brackish or marine water, and improved energy efficiency.



Alfa Laval PureBallast 3.1 is 50 percent smaller than its predecessors and uses up to 60 percent less energy.

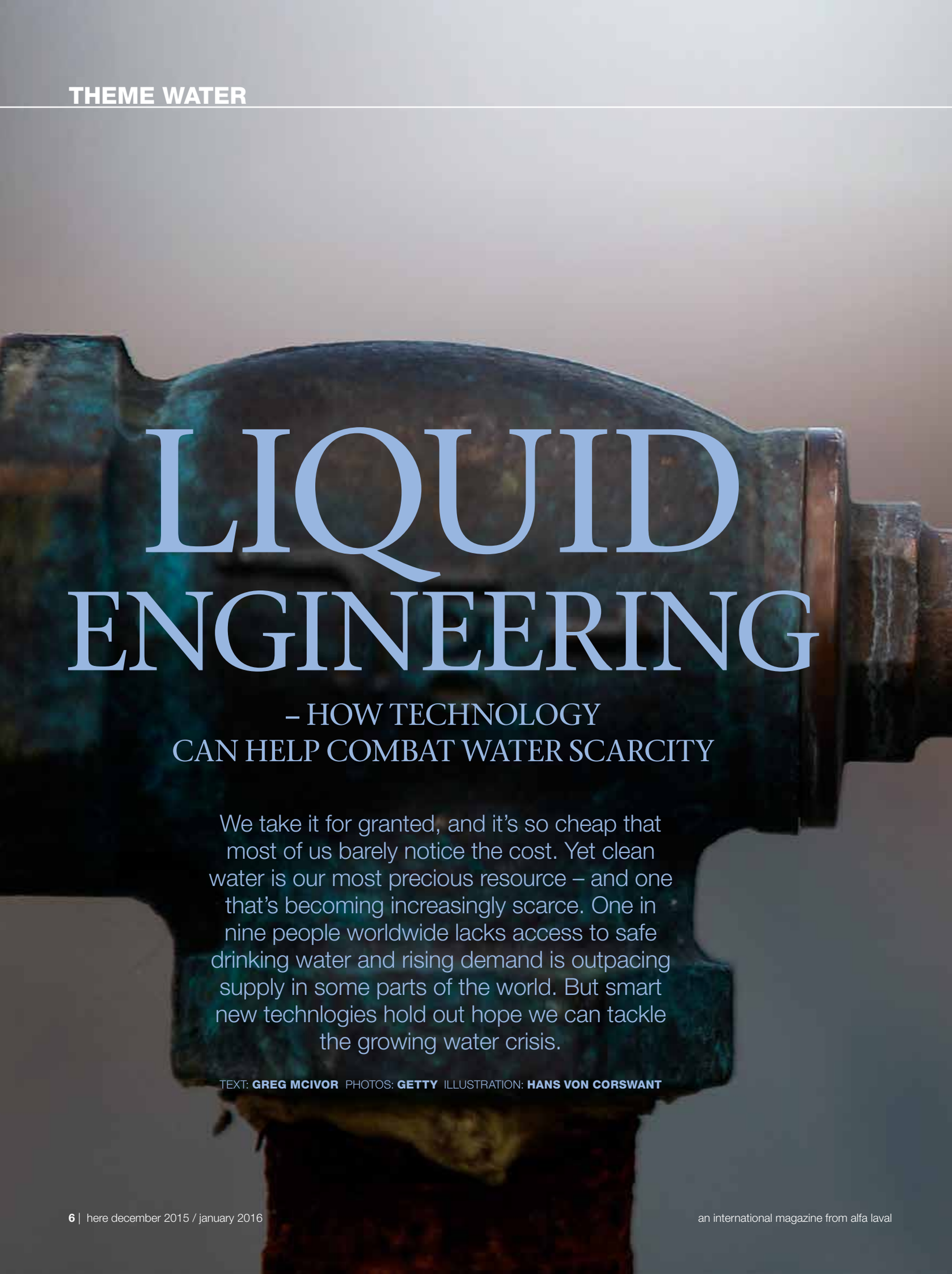
Next generation in efficient cooling launched

In industries ranging from food and beverage to textiles and metal processing, cooling towers are often considered for cooling, but a considerable drawback is that they can pose environmental or performance challenges.

In order to meet the cooling needs of users in these industries plus many others, while meeting environmental and performance needs, Alfa Laval has launched Alfa Laval Abatigo. This closed-chamber adiabatic cooler is optimized for a number of different applications to deliver long-term savings in water, energy, chemicals and maintenance time.

Alfa Laval Abatigo reduces water consumption by up to 95 percent compared with a cooling tower and uses 95 percent less energy than an air-cooled central chiller.

It utilizes a unique cooling method: a fine mist of water is sprayed to cool the air before it enters the heat exchanger coil. This significantly reduces energy and water consumption, and is highly adaptable to different applications and climates. The closed adiabatic chamber prevents any water drift to the heat exchangers, keeping them completely dry, preventing scaling, erosion, and dangerous waterborne bacteria such as Legionella.



LIQUID ENGINEERING

– HOW TECHNOLOGY CAN HELP COMBAT WATER SCARCITY

We take it for granted, and it's so cheap that most of us barely notice the cost. Yet clean water is our most precious resource – and one that's becoming increasingly scarce. One in nine people worldwide lacks access to safe drinking water and rising demand is outpacing supply in some parts of the world. But smart new technlogies hold out hope we can tackle the growing water crisis.

TEXT: **GREG MCIVOR** PHOTOS: **GETTY** ILLUSTRATION: **HANS VON CORSWANT**

There are roughly

1.38 bn

cubic km of water on the planet

Total water withdrawal per capita, highest and lowest:

United States of America

1,630m³ per year

Democratic Republic of the Congo

11m³ per year

When Hollywood star Tom Selleck found himself accused of water-stealing this summer, the news travelled far beyond his home state of California, currently enduring its fourth year of severe drought. The case, which the ex-Magnum actor settled out of court, underlined how water scarcity knows no boundaries and can afflict the wealthiest societies as well as the poorest.

Around 880 million people are without access to safe drinking water and 2.5 billion lack basic sanitation. Astoundingly, more people own a mobile phone than have access to a working toilet. Bad water causes more than 2 million deaths a year, most of them children.

Such statistics have prompted the United Nations to declare access to clean, safe water a human right. But fulfilling that right is getting ever harder. Over the next 50 years, population growth, urbanisation and changing lifestyles will require 55 percent more water than currently available.

AS THE GLOBAL population soars and agriculture – by far the largest consumer of water – expands to feed our constantly growing towns and cities, intensive extraction is depleting water tables from the US to India and China to Brazil.

According to McKinsey, by 2030 water supplies will satisfy only 60 percent of global demand, and less than 50 percent in many developing regions where water supply is already under stress.

"We must transform the way we think about water. By 2025, 1.8 billion people will be living in regions without enough water. Water scarcity is the greatest challenge we face today," says Peter Brabeck, chairman of the Swiss multinational Nestlé.

How to respond? The starting point, Brabeck believes, is to put a proper value on water. "We need to start recognizing that water is a precious resource. It needs to be better managed, better valued and better preserved."

"We've made enormous progress improving the water supply. But you're always playing catch-up as you try to reach the last billion people on the planet."

ADRIAN MCDONALD, PROFESSOR OF GLOBAL WATER SECURITY AT THE UNIVERSITY OF LEEDS.

One way is to use water more efficiently. Even in developed countries like the UK, many homes lack water meters. This means people can use as much water as they like at no extra cost.

Adrian McDonald, professor of global water security at the University of Leeds, notes that metering rates are gradually improving, in the UK at least, but stresses wide-ranging measures are needed – at global level – to tackle water scarcity effectively.

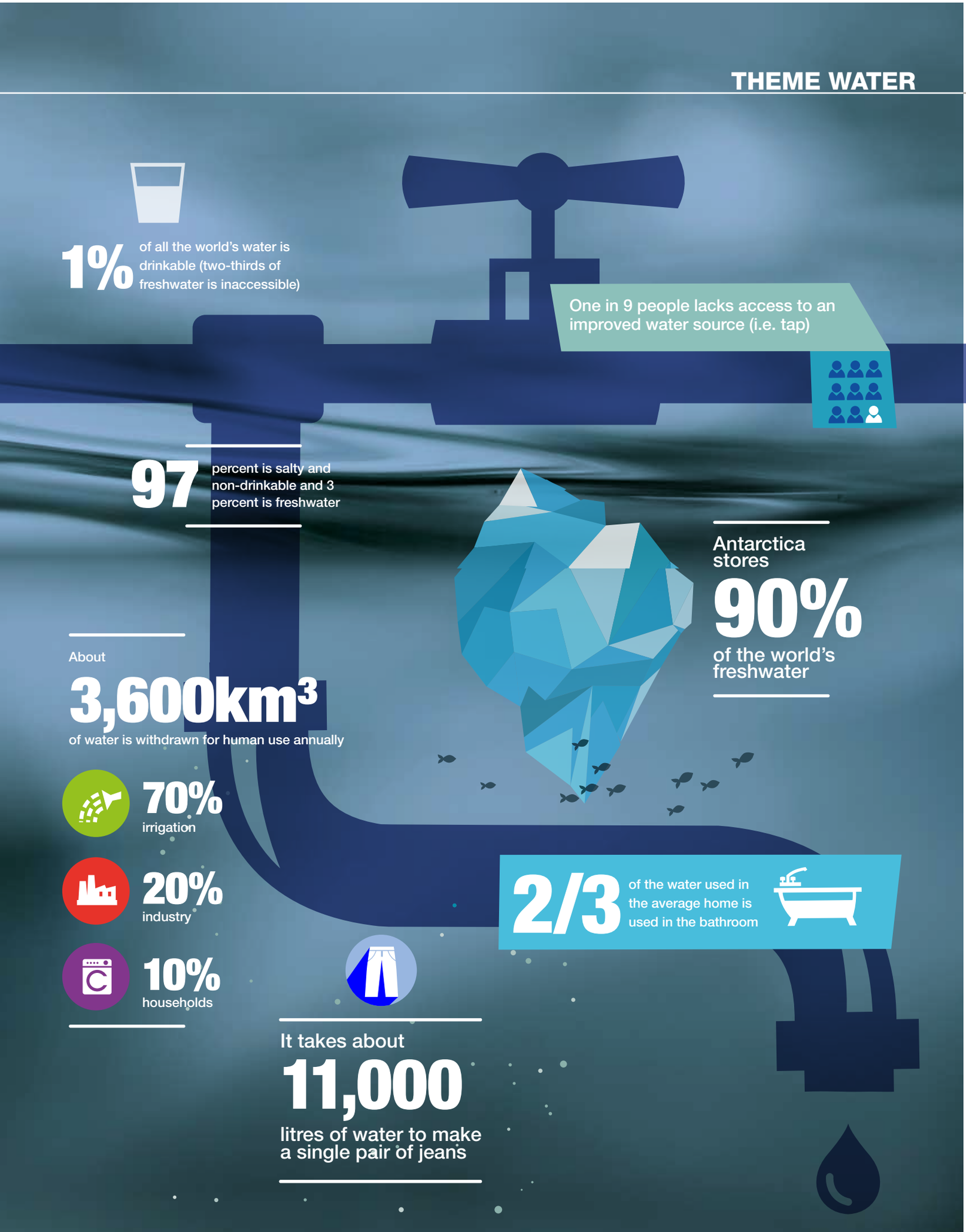
"We've actually made enormous progress, improving the water supply to tens of millions of people. But the population has been increasing at roughly the same rate so you're always playing catch-up as you try to reach the last billion people on the planet."

There is no magic bullet and a raft of initiatives is needed. These include making supply more resilient, reducing inequalities in access to water and sanitation services, strengthening systems and planning, and promoting sustainable development by integrating water, sanitation and hygiene with water resource and waste management.

Across these areas, technology has a pivotal role to play – whether in the home, in industry or in water distribution systems. At household level, waterless toilets are just one of multiple innovations that can help to improve hygiene and reduce water use. Toilets account for some 30 percent of household water use. Each flush of a conventional toilet requires 11 litres of water.

One of prime movers is the Bill and Melinda Gates Foundation, whose Reinvent the Toilet Challenge aims to bring sustainable sanitation to the 2.5 billion people lacking safe, affordable sanitation by introducing innovative toilet systems that do not require water.

Such toilets are already being used in Africa, including in Kenya and Uganda, and scientists want to expand their use to India and China. One toilet, developed by scientists at the University of Colorado Boulder, uses solar power to transform faeces into biochar that can then be used as agricultural fertiliser.


1% of all the world's water is drinkable (two-thirds of freshwater is inaccessible)
One in 9 people lacks access to an improved water source (i.e. tap)
97 percent is salty and non-drinkable and 3 percent is freshwater
Antarctica stores 90% of the world's freshwater
About 3,600km³ of water is withdrawn for human use annually
70% irrigation
20% industry
10% households
2/3 of the water used in the average home is used in the bathroom
It takes about 11,000 litres of water to make a single pair of jeans

WATER PURIFICATION IS another key area. One of the more ingenious innovations currently being touted is a vortex bioreactor developed by Plymouth Marine Laboratory (PML) in the UK and part-funded by the Bill and Melinda Gates Foundation.

Currently being tested in India, the bioreactor decontaminates wastewater by spinning it through beads of copper alloy – a process that destroys bacteria.

Mike Allen, microbial biochemist at PML, believes it has the potential to revolutionize the treatment of wastewater in the developing world.

"The beauty of the system is it's completely scalable: we can design and build systems that work at the toilet block, village or city scale depending on the requirement. Depending on the size of the system, it can be driven by hand, bicycle or by motor," he says.

Erik Harvey, a specialist at the global non-profit organisation WaterAid, adds: "What really impresses me [with the vortex bioreactor] is that you're taking 100 litres of water at one end and purifying it in the space of a few minutes and essentially with no chemical input. This is highly unusual."

More established technologies, including micro and ultra filtration and reverse osmosis (also used in desalination), are already part of the water purification armoury.

"Increasingly, we are seeing a lot of innovation in this space in terms of making water clean, available and potable. This is both on the recycling side – getting used water back into use in a way that is eco-friendly and quick – and also closing the gap by increasing supply, for instance through desalination and using sand dams to harvest rainwater in areas like the Sahel in Africa," Harvey says.

In agriculture, Adrian McDonald highlights the bioengineering of water-efficient plants, drip irrigation technologies and the use of only partially cleansed water as ways to enhance water husbandry.

The great paradox of the water crisis is that there is more than enough fresh water in the world to meet everyone's needs. Indeed, we only use a tiny proportion of available fresh water. The problem is that the water is not available in sufficient quantities where people need it.

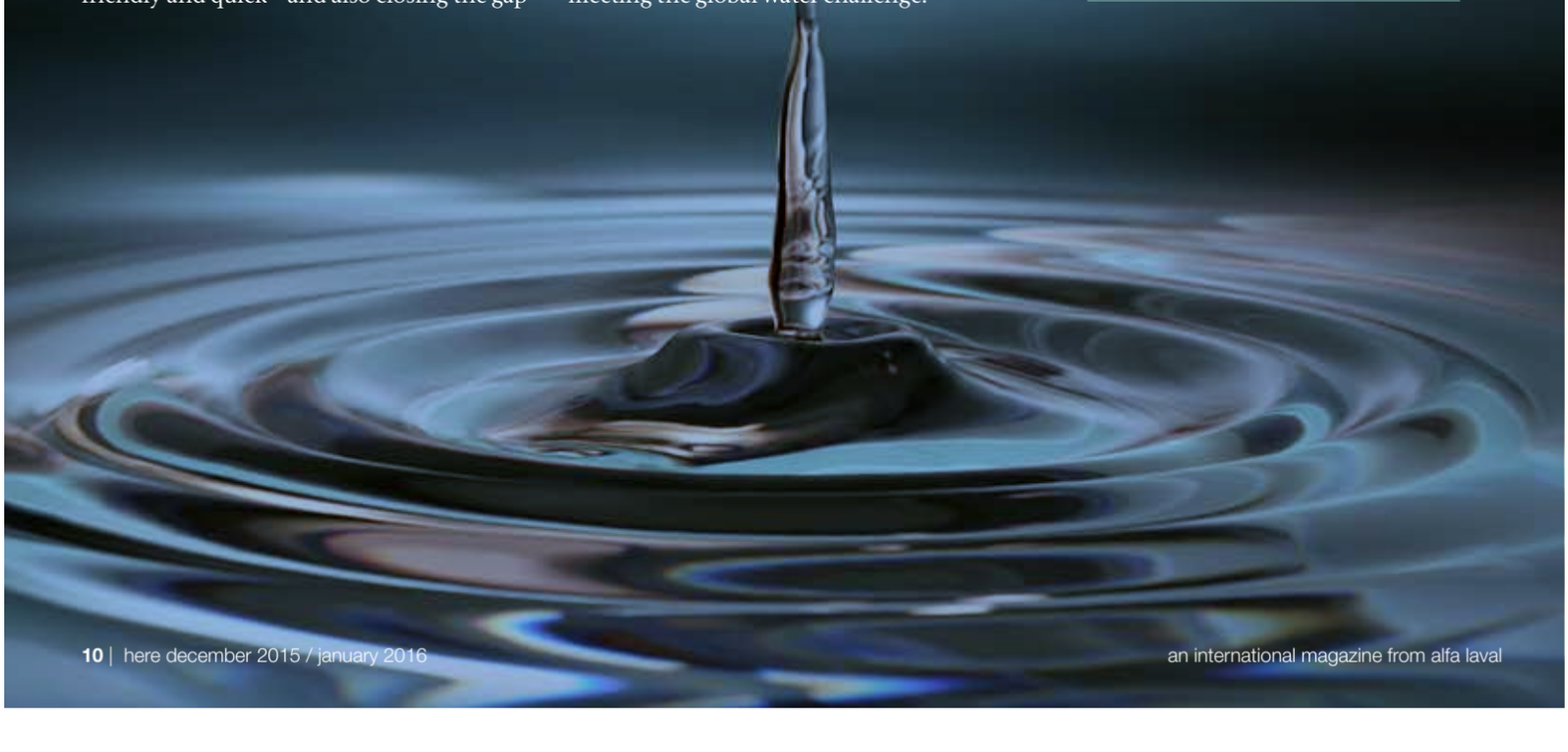
ON THE DISTRIBUTION SIDE, man has been moving water from one place to another since the Romans built their aqueducts 2,000 years ago. More adventurous solutions in a modern context range from transnational water pipelines to towing Antarctic icebergs to arid nations.

But such arrangements are expensive and energy-intensive. Increasing supply through transporting surface water or drilling deep wells will be extremely difficult and expensive, warns Giulio Boccaletti, a former McKinsey partner who now leads the Nature Conservancy's global freshwater programme. More likely, he says, governments will need to manage demand by raising the price of water or by capping the amount of it that users can draw.

Doing this in tandem with smart technologies that save water and treat it more effectively offers our best chance of meeting the global water challenge.

Things you may not know about water:

- Your bones are composed of 31% water
- Hot water is heavier than cold water
- There is a reservoir of water in space that has 140 trillion times more water than the world's oceans, according to Nasa.
- Water itself does not conduct electricity well but the impurities in it do.
- Your probability of finding in any glass of water at least 1 molecule of water once drunk by Cleopatra is practically 100%.
- Water is light turquoise-blue due to weak absorption in the red part of the visible spectrum.



CLEAN WATER
IS A HUMAN RIGHT – AND AN OPPORTUNITY

"It's sobering to know that so many people lack the right to clean water, something that's a basic need for survival," says Catarina Paulson, Alfa Laval Head of Corporate Social Responsibility.

As water security climbs up the global agenda, the United Nations has made "the availability and sustainable management of water and sanitation for all" one of its new goals for achieving sustainability by 2030.

Alfa Laval aims to play its part in helping to achieve this target in a variety of ways, Catarina says. "Knowing that Alfa Laval has products that can help clean wastewater and reduce the water used in processing gives me hope."

She adds: "We also have to take care of how we do things and consider this in the way we manufacture, sell and service all our products. Even if Alfa Laval's own relative use of water is very low in our production process, we work to use water even more efficiently, especially in areas where water is scarce."

Thomas Møller and Catarina Paulson

INDUSTRIES ARE FACING increasing challenges in accessing clean water and disposing of wastewater, says Thomas Møller, Alfa Laval Segment Manager, Process Water & Waste Treatment. The lack of clean water is both due to water scarcity and because the water that factories extract from watercourses for use in production is increasingly dirty due to rampant pollution.

"River water in China, India and many countries is a very different animal from 10 years ago. Earlier, you could maybe take up groundwater that was perfectly clean, but surface water is much more polluted now. Your water intake system has to be quite sophisticated over multiple steps compared to in the past. This situation, combined with tougher legislation on wastewater disposal, also drives business cases for water re-use," Møller says.

This explains the growing demand for technologies that can purify water before it enters the industrial process or recover clean water from effluent.

For instance, India in 2015 set a three-year target to rejuvenate the chronically polluted River Ganges by installing sewage treatment plants and adopting zero liquid discharge technology (ZLD), which reuses all industrial wastewater (after appropriate treatment) without discharging a single drop into any river.

IN THEIR QUEST for clean input water, countries from China to Australia and regions from South East Asia to Europe are investing billions of dollars in desalination – a former niche industry now expanding rapidly.

Technology has developed so far that the major challenge today is not so much how to purify water and wastewater but how to do it affordably. "There are technologies available that clean the dirtiest water you could ever imagine. But it comes down to what is the most cost-efficient way of doing it, and that's where the big innovation driver is," Møller says.

"There are so many embryo technologies around and literally thousands of projects and billions of euros being spent on R&D. The end use is also very important – whether you want the water for drinking, food processing and cleaning or for oil and gas refining and process industries. All these have very different demands on water quality. There is no single solution that fits all."

Here, Alfa Laval offers a wide spectrum of solutions – from desalination and water supply systems to biological wastewater and sewage sludge treatment and systems for enhanced water efficiency and ballast water treatment.

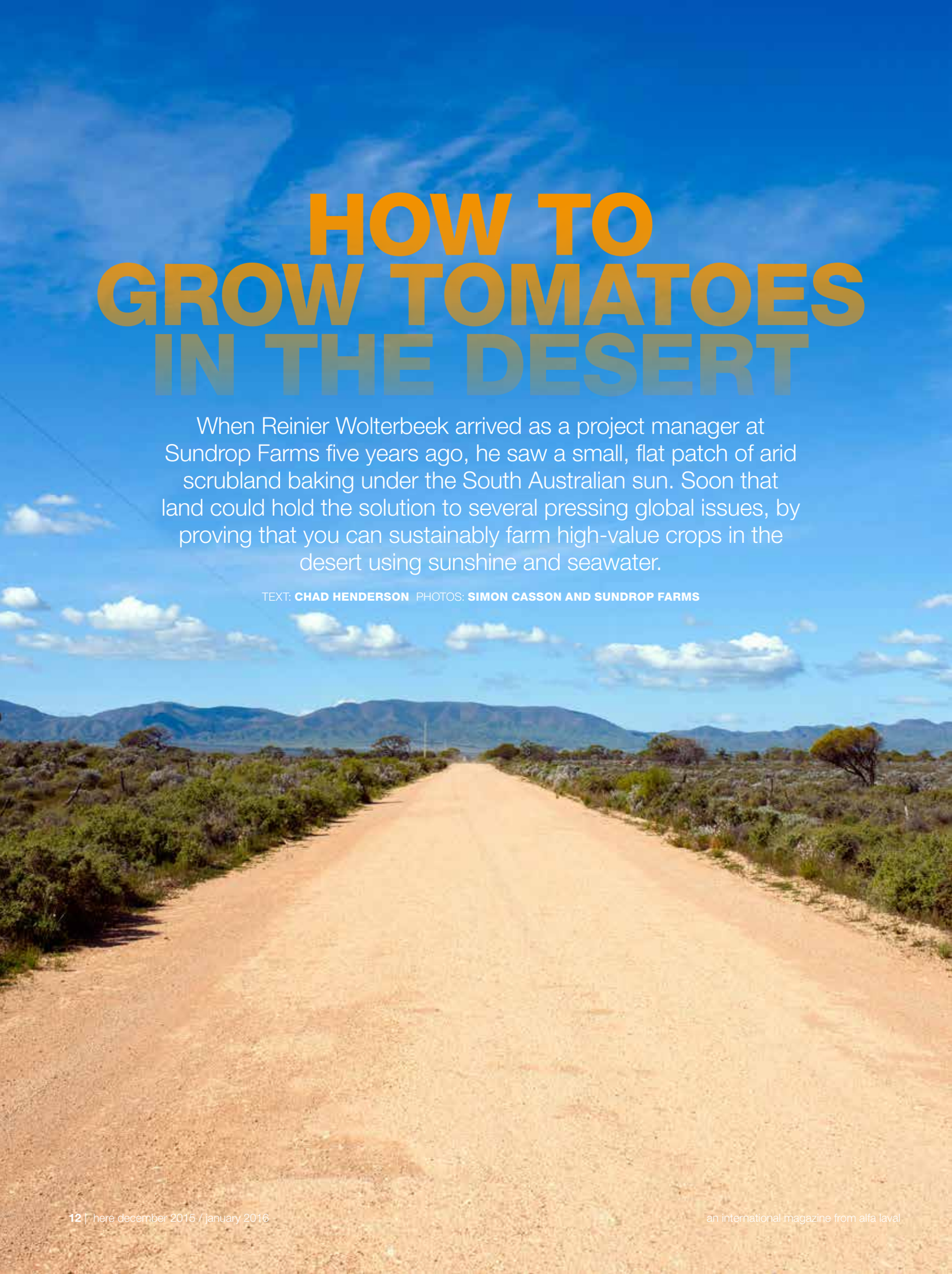
"We have a lot of products that will fit into UN's new sustainable development goals," Paulson says.

"On the business side, it's an opportunity and on the human rights side it's a way of acknowledging that access to clean water is something we simply must work towards." ■

HOW TO GROW TOMATOES IN THE DESERT

When Reinier Wolterbeek arrived as a project manager at Sundrop Farms five years ago, he saw a small, flat patch of arid scrubland baking under the South Australian sun. Soon that land could hold the solution to several pressing global issues, by proving that you can sustainably farm high-value crops in the desert using sunshine and seawater.

TEXT: **CHAD HENDERSON** PHOTOS: **SIMON CASSON AND SUNDROP FARMS**



GOOD DAY SUNSHINE: Mirrors reflect the radiant energy from the sun -- which shines 300 days a year here -- on to the central tower, where the solar energy is converted into thermal energy.

Wolterbeek, now the CTO of Sundrop Farms, says the vision for the company started with the idea of taking the volatility out of farming. "Agriculture is a quite volatile business, both on the revenue and cost sides," he says. "Utility prices are always going up and down, basically following oil prices, and water prices are endlessly going up – it's not a very attractive business. To make it more attractive, we tried to find which of those fluctuations in the market we could stabilize, by providing sustainable sources of energy and water."

SUNDROP FARMS IS BUILDING a massive greenhouse complex with a technological solution and commercial scale that has never been attempted before. A state-of-the-art integrated solar energy system, provided by Aalborg CSP, will heat the greenhouses, produce electricity and generate energy to run a desalination unit from Alfa Laval, which will produce freshwater to irrigate the crops.

Wolterbeek says that another farming challenge is that all of the good agricultural land is already taken. Which is why he found himself watching a fence being built around that patch of arid Australian scrubland five years ago.

To Wolterbeek and the Sundrop Farms team, however, the location they chose was perfect. The company built a pilot project, consisting of a hydroponic greenhouse powered by solar energy. The farm – about 16 kilometres southeast of Port Augusta – receives 300 days of sunshine per year, and saltwater is obtained from the nearby Spencer Gulf.

AFTER THREE YEARS of trial and error, including honing skills with different high-value crops and technologies, Sundrop Farms decided it had enough experience in the system to roll out the development, ownership and operations of the Sundrop Farms greenhouses.

"We wanted to grow our operations several hundred-fold, and to get there we needed additional equity," says Wolterbeek. "It was difficult at the start, because for the general investment funds and banks it wasn't clear what we were, whether we were agriculture, infrastructure or renewable."

Finally, Sundrop Farms partnered with KKR, a global investment firm that enabled the company to realize its expansion both in Australian and in other interesting markets abroad, with the remaining funds coming from Australian banks.

"With the growing population we need more produce. But on the other hand we have limited resources, like fossil fuels, and freshwater is under severe stress in certain regions with long-term droughts," says Wolterbeek. "Our solution could have a really big impact."

Sundrop Farms' expansion project in Australia, which should be complete in October 2016, uniquely combines technology from some of the top suppliers in their respective fields.

At the heart of Sundrop Farms is the integrated solar energy system supplied by Aalborg CSP, which has cooperated with Alfa Laval for several years. The system will be capable of providing freshwater by desalinating seawater, heating the greenhouses in wintertime and on cold summer nights, and running a steam turbine to produce electricity.

"With the growing population we need more produce. But on the other hand we have limited resources, like fossil fuels, and freshwater is under severe stress in certain regions with long-term droughts. Our solution could have a really big impact."

REINIER WOLTERBEEK, CTO, SUNDROP FARMS

SUNSHINE AND SEAWATER

“These mirrors reflect the radiant energy to a receiver in the tower. The receiver is basically an advanced boiler system that absorbs the radiant energy and converts it to thermal energy.”

SVANTE BUNDGAARD, CEO OF AALBORG CSP

SUNDROP FARMS: The CSP system explained

- Radiant energy from the sun hits a field of mirrors that have a combined surface area of more than 50,000 sq metres. Together they are capable of producing 267,000 MWh on a perfect solar day.
- The mirrors, curved in a D shape around the south side of a 116-metre-high tower, reflect the radiant energy to a receiver on the tower. The receiver – an advanced boiler system – converts the solar energy into thermal energy, which runs the desalination unit, drives a steam turbine, and heats the greenhouses.
- Of the 44 gigawatt hours of energy produced each year, 40 percent is used to produce freshwater in Alfa Laval’s desalination unit, 50 percent is used for heating, and ten percent for electricity.
- During the winter period, a diesel backup boiler sustains production. It accounts for about five percent of total annual energy production.

REINIER WOLTERBEEK: Our solution could have a really big impact..

SVANTE BUNDGAARD: This project has incredible potential to solve one of the biggest issues we face.

Svante Bundgaard, CEO of Aalborg CSP, says that Sundrop Farms’ integrated solar plant will be based on concentrated solar power (CSP) tower technology. “Radiant energy from the sun hits a number of mirrors,” he explains. “These mirrors then reflect the radiant energy to a receiver in the tower. The receiver is basically an advanced boiler system that absorbs the radiant energy and converts it to thermal energy. The thermal energy is used to drive the steam turbine, heat the greenhouses and run the desalination unit.”

UNLIKE A PHOTOVOLTAIC power (PV) plant, which only produces electricity, the unique, integrated solar energy plant at Sundrop Farms will produce multiple streams of energy that can be both stored and used to run several operations on the farm. The desalination unit from Alfa Laval will be the largest solar-powered unit of its kind ever made. The unit works by using steam generated by solar energy to evaporate seawater into pure water vapour.

“This project has an incredible potential to solve one of the biggest issues we face: providing food to a growing global population while arable land decreases,” says Bundgaard. “Sundrop Farms has built a profitable business case that can be used to sustainably produce food in similar climates around the world.”

The expanded Sundrop Farms will focus on producing truss tomatoes, and aims to grow 15,000 metric tonnes per year. The Australian supermarket chain Coles has already signed a ten-year contract to buy the tomatoes.

These days Reinier Wolterbeek works from Sundrop Farms’ London office, where he is making plans to duplicate the Port Augusta facility in other parts of the world. Sundrop Farms has already opened an office in the Middle East and is looking at other regions with similar climates.

“This is the best job I’ve ever had and ever will have,” he says. “I think it’s great. I’m doing exactly what I always wanted to do, making freshwater for agricultural purposes, and we’re doing it in a sustainable manner, which is even greater.” ■

SUNSHINE AND SEAWATER

GREEN GROWTH: A supermarket chain has signed a ten-year contract to buy the sustainably grown tomatoes from Sundrop Farms.

SUN, SEA AND SALT:
How solar-powered desalination works

■ The Alfa Laval multi-effect desalination (MED) unit is based on the evaporation of seawater. Solar energy heats seawater feed in a titanium-plate heat exchanger. Part of the seawater flow is evaporated to pure water vapour.

■ The water vapour is then utilized as evaporation energy for the subsequent effect, after which the same process is repeated several times corresponding to the number of effects. The water vapour generated from the last effect is condensed in the main system condenser cooled by seawater. The solar desalination freshwater is then used to irrigate crops.

■ "This project was a fantastic opportunity to further advance our desalination technology," says Steen Rosenbom, Business Manager, Oil & Gas Technology, Alfa Laval. The company has more than 50 years' experience around the world in desalination. "We hope this project will be an example to others, where high-quality freshwater can be produced at a low cost, using only solar energy."

ADRIAN SIMKINS, HEAD GROVER

THE QUEST FOR THE HOLY ALE

While the traditional beer market is stagnating across the world, craft beer is flourishing. But scaling up production while keeping quality high can be a challenge. Boston's Harpoon Brewery found an effective solution in the Alfa Laval Rotary Jet Mixer.

TEXT: **ULF WIMAN** PHOTOS: **HARPOON**

The times they are a-changing. It used to be that a beer should be large, light-tasting and cold – complete with a refill function. And while this still holds true for many consumers, today's discriminating beer connoisseurs go for quality over quantity.

Small, independent craft breweries are emerging all over the world, challenging the established brewery giants. The USA is something of a forerunner and here the craft beer segment has been all but overflowing the past 30 years.

THE NUMBER of brewpubs surged in the late 1990s and the number of microbreweries has increased strongly in the 2010s. According to US trade group Brewers Association, the craft beer segment more than doubled between 2008 and 2014, adding up to 3,418 out of a total of 3,464 breweries. You have to go back to the 1870s to equal that. In 2014, craft beer had an 11 percent market share in the USA, while sales reached USD 19.6 billion, a 22 percent rise compared to 2013.

Harpoon Brewery in Boston, Massachusetts, was one of the craft beer pioneers. The company got started in the 1980s when the enthusiastic founders travelled across Europe searching for the kind of beer that they missed back home.

Today, Harpoon has grown into the twelfth largest US craft brewery, with production in Boston and Windsor, Vermont. But scaling up the capacity has not been without challenges, such as when bigger tanks in the Boston brewery required a new approach to adjusting alcohol and CO_2.

A TECHNOLOGY search turned up Alfa Laval's versatile and effective Iso-Mix system, which is based on the company's Rotary Jet Mixer technology. Harpoon vice-president and chief brewing officer Al Marzi says: "The Iso-Mix system provides us with a fast, consistent way of adjusting CO_2 content and gravity, as well as making other additions that ensure less manual labour and reduced risk of delays in our packaging operations."

Chief brewing officer Al Marzi.

The system also provides an added operational bonus, as explained by cellar manager Aaron Moberger: "Since the Alfa Laval Rotary Jet Mixer is also a very efficient tank-cleaning machine, it has allowed us to redesign our cleaning-in-place procedure such that it has become much safer to operate."

With the right equipment in place, Harpoon Brewery keeps on hitting the spot with unique, flavourful ales, ciders and more. As they say themselves: "Love Beer. Love Life."

TECHNICAL INSIGHT:
ALFA LAVAL ROTARY JET MIXER

- A skid-mounted pump module draws beer from the bottom of the tank and returns it back into the tank through the nozzles of the Alfa Laval Rotary Jet Mixer, which rotates on two axes to churn the entire volume in the tank with maximum effectiveness. Operators can add water to the circulation loop on the suction side of the pump in order to adjust gravity, and natural flavours can also be added here to adjust the flavour profile. Meanwhile, CO_2 can be added in appropriate amounts on the pressure side of the pump to adjust the carbon dioxide content of the beer.

- Alfa Laval's Rotary Jet Mixer helps reduce capital expenditure and operating expenses while achieving fast and efficient mixing. A single Rotary Jet Mixer can handle liquid mixing, gas dispersion and powder dispersion applications – plus tank cleaning – without requiring separate equipment for each process, and thereby delivering significant savings.

- Alfa Laval's Rotary Jet Mixer is used for mixing in beer fermenters. Applying forced mixing in beer fermenters reduces processing times by up to 30 percent.

ENVIRONMENTAL RESCUE BENEATH THE WAVES

While sunken shipwrecks might evoke thoughts of gold bullion, drama and mystery, the reality is that what lies on the seabed is more likely to be an environmental threat than a treasure trove. The fuel oil aboard Second World War wrecks lying off the Norwegian coast poses a major hazard to local marine life, but a specialized pumping system from Framo has been developed to safely and remotely remove these toxic substances.

TEXT: **AMY JOHANSSON**

There is a hidden threat lurking on the seafloor off Norway. Norwegian coastal authorities have classified 30 shipwrecks, of German, British and Norwegian origin that have been buried since 1940-1945, the period of the nation's wartime occupation. While the saying goes "dead men tell no tales", these wrecked vessels continue to pose a threat to the marine ecology of their watery grave.

Constructed and operated during an era of coal-based fuel oils, the metal of the vessels' structures may corrode and oil and fuel leak out as the years pass. International coastal agencies, national coastal authorities and marine ecologists have long sought solutions to this growing toxic threat.

There is, however, no simple fix to this widespread problem. Norway's waters are deep – and rugged, and cold. In the past, divers had the painstakingly slow, risky and costly task of offloading these vessels. But today the exposure risk for divers, both to the frigid water and to the leaking toxins near the wreck, is judged to be too high, while regulations anyway limit air dives to 30-50 metres. There is also the threat of undetonated explosives in the vessels' cargo.

Framo's Remote Offloading of Sunken vessels (ROLS) system, which entered development in the 1990s, finally offers a safer and more cost-effective solution, with no need for divers. A slim, manoeuvrable Remote Operated Vehicle is navigated down to the wreck, where it drills through the side of the vessel and empties the tanks of the hazardous fuel oil and cargo. The waste is then disposed of onshore according to regulations.

The company, with its extensive marine experience, and globally trusted brand of submersible pumps, has successfully carried out 16 operations since for the Norwegian Coastal Authority and others. There have been five additional successful operations conducted with the latest generation ROLS XO system, following its debut in 2012.

As the result of a serious incident in 1977, Norway has the world's strictest regulations on oil spill contingency and is considered a world leader in oil spill prevention and response. The Norwegian Oil Spill Control Association (Nosca), of which Framo is a member, brings together the private sector, R&D institutions and government pollution control authorities to develop equipment and contingency planning for oil spill emergencies.

IN JUNE 2015, the sunken Second World War vessel Eric Giese was emptied of oil. It was the last of four vessels in the Narvik/Lofoten area to be made safe under Framo's contract with the Norwegian coastal administration.

"Our new ROLS XO has proven to be an unique tool for recovering oil from sunken vessels," says Terje Ljones, Sales Manager, Oil Recovery Systems at Framo. "We can never completely safeguard ourselves from oil spills, but with our innovative solutions and continuous refining of our products, Framo has proven to be prepared for any challenge." ■

1938
Company founded by Frank Mohn. Pumps used for emptying herring from fishing boats.

1960s
First company to apply hydraulic drive to marine pumps

1970s
Enters the North Sea offshore market

2014
Acquired by Alfa Laval

FRAMO:

From local player to a world leader

Over a half century Framo – formerly know as Frank Mohn AS – has grown from a small supplier of pumps to Norway's herring fleet to a world leader in submerged pumping systems, with its products deployed on cargo tankers, oil tankers and oilrigs around the globe. It is the largest company ever acquired by Alfa Laval.

In action off the Norwegian coast

"We can never completely safeguard ourselves from oil spills, but with our innovative solutions and continuous refining of our products, Framo has proven to be prepared for any challenge."

TERJE LJONES, SALES MANAGER, OIL RECOVERY SYSTEMS AT FRAMO.

The Framo ROLS is prepared to enter the water

Now part of the Alfa Laval Group, Framo offers unique pumping systems to the marine and offshore markets and has an exceptional service focus.

- **MARINE SOLUTIONS:** Framo´s hydraulically driven, submerged cargo pumping system provides safe, efficient and flexible cargo handling. System efficiency secures higher vessel utilization, which means ship operators can earn more money. Ships with Framo pumping systems fetch a premium on the second-hand market.
- **OFFSHORE SOLUTIONS:** Framo offers pumping systems for offshore and onshore applications. Suitable for fire water pumps, seawater lift pumps and cargo pumping systems for offloading, the systems help meet the increasing focus on efficiency, uptime and reliability
- **OIL RECOVERY SOLUTIONS:** Framo offers high capacity systems for recovering any kind of crude oil or refined oil whether on sea surface from oil spill or from sunken vessels.
- **SERVICE OFFERING:** Much of the reason Framo has an excellent reputation in the market is down to the quality of service. From commissioning and training to regular service and a comprehensive spare parts offering, customers buying Framo systems across the world expect – and receive – the very best customer care.

TECHNOLOGICALLY, Framo has always been at the forefront, improving, researching and developing systems for its customers. The technological innovation stems from the good relationships built over time with shipowners.

Despite fluctuations in the market, Framo has grown continuously. Ivar K. Johannessen, Managing Director of Framo Services AS, attributes this growth to three main factors: technology, service and a complete system approach.

"We understand more than just the pumping system. We have to understand their business and operations," he says.

The 2014 acquisition by Alfa Laval has been positive both for Framo and for its customers. "Our customers know us, and they know Alfa Laval," adds Johannessen. ■

IN SHORT: **FRAMO**

- **FOUNDED:** 1938
- **WORLDWIDE LOCATIONS:** Bergen, Busan, Shanghai, Tokyo, service sites in Singapore, Rotterdam, Houston, Dubai, Luanda , Mexico City and Rio de Janeiro
- **HEADQUARTERS:** Bergen, Norway
- **SYSTEMS AVAILABLE:** Cargo pumping systems, fire water systems, seawater lift pumps, water injection pumps, cavern pumps, oil recovery systems (Transrec), emergency offloading equipment, and special equipment for offshore applications.

‘Roof of the world’ gets unique heating solution

Despite being closer to the sun than most places on Earth, the Tibetan capital, Lhasa, has a frosty climate that makes effective building heating essential. The city’s first centralized heating system relies on Alfa Laval gasketed plate heat exchangers to keep residents warm.

TEXT: **JAN HÖKERBERG** PHOTO: **GETTY**

Deep in the spectacular Himalayas, at an altitude of around 3,600 metres, the city of Lhasa is known as “the roof of the world”. With a cultural and spiritual history spanning over 1,000 years, Lhasa was for long the centre of Tibetan Buddhism and is now the capital of the Tibet Autonomous Region of the People’s Republic of China.

Because of the high altitude, Lhasa has a cool semi-arid climate with frosty winters and mild summers. Heating of buildings is therefore essential.

FOR THE FIRST TIME in China, a centralized heating system has been installed at such a high altitude. The Lhasa Educational District project, which comprises schools, a university and other educational institutions along with residential buildings, uses gasketed plate heat exchangers in its heating system. Construction started in 2012 and the district will accommodate 50,000 people when ready at the end of 2015.

The city’s public utility, Lhasa Nuanxin Gas Heating, chose Alfa Laval to ensure safe and highly efficient performance.

“At high altitude, it’s not easy to carry out maintenance, so the client needed to select a product with a stable and good performance,” says Ryan Guo, project manager for heat exchanger systems at Alfa Laval in China. “Since the substations are located far from each other, the product also needed to have an advanced control system with a web-based solution. This way the customer can easily read and write the data remotely, using a terminal unit such as a computer or a smartphone.”

THE MOTOR AND THE electric components had to be adapted for the high-altitude working conditions. “Because of the low air pressure we adjusted the calculation of the gasket plate heat exchanger and the circulation pumps to make sure the components could achieve the best performance,” Guo explains.

Crucially for the customer, Alfa Laval’s control system has proved that it can reduce annual energy consumption by 10 to 15 percent. ■

FROM ONE EXTREME TO ANOTHER

Alfa Laval is a world leader in heat exchanger systems that meet the challenge where the climatic going gets tough.

+50° **CLOSE TO THE CITY** centre of Qatar's capital, Doha, the man-made island of Pearl Qatar spans almost 4 million square metres.

The area bakes in temperatures up to 50°C, but the island's residential, entertainment and retail areas are cooled by the largest integrated district cooling plant (IDCP) in the world. Reliability and performance are key factors for the plant, and more than 120 Alfa Laval plate heat exchangers are key components.

-50° **TEMPERATURES IN PARTS** of Siberia can drop far below minus 50°C, and the heating infrastructure there is often in dire need of renovation.

Investments in municipal heating projects have included hundreds of Alfa Laval heat exchangers for individual thermal substations, small boilers as well as central heating substations. The result: significant energy savings and improved reliability.

Because of Lhasa's mountaintop setting high in the Himalayas, the city's first centralized heating system posed a number of challenges — which Alfa Laval was able to solve.

RESPONSIBLE OIL PRODUCTION IN THE AMAZON

Extracting heavy crude oil from a delicate environment presents multiple challenges for Perenco. Alfa Laval's centrifuge technology helps ensure the operation is viable.

TEXT: **DAVID NIKEL** PHOTO: **PERENCO, GETTY**

When new oil fields were discovered deep within the Amazon rainforest in 2006, Peru's then-President, Alan García, declared the find a "miracle" for the country's economy. It was the first new oil field put into production in Peru in 30 years. Nine years on, the real miracle is not the oil in the ground: it is the fact that oil can be extracted from this location at all.

BLOCK 67 IS LOCATED in one of the most inaccessible parts of the world, let alone Peru. To reach the site, workers must take a 90-minute flight from the capital Lima to Iquitos, which lies at the swampy confluence of the Amazon, Nanay and Itaya rivers. The jungle metropolis of Iquitos is the largest city in the world that cannot be reached by road, but the journey to Block 67 is far from over.

A two-day speedboat journey along the Amazon to the specially constructed terminal is followed by a helicopter flight to the site itself. Construction equipment and supplies must be transported by barge with a minimum journey time of ten days. To transport the oil away from the site, a 200km buried pipeline was constructed.

"WE ARE GUESTS IN THE JUNGLE," explains Perenco's Benjamin Barraud. "Nobody lives anywhere near Block 67 except a few indigenous communities. It's virgin forest so we have a duty to minimize any disruption to the environment. Every decision is taken with a view to minimizing the footprint we leave behind."

"It's a harsh environment to work in because of the logistics but also the climate. It rains every day and there is no dry season. Constructing anything in wet mud is not straightforward."

As the world's energy demands continue to rise and conventional oil finds become rare, unconventional sources of oil such as deep-sea reserves and shale

The Alfa Laval centrifuge in operation. Three discoveries of oil, totaling 200m barrels, have been found in Block 67.

deposits are now being exploited. Governments and oil companies are also taking a second look at deposits of heavy crude oil, previously thought of as uneconomical.

Perenco holds a 50 percent interest in Block 67 in the Marañón Basin, located in the north east of the Loreto region, along with the Vietnamese national company PVEP. To date, three discoveries have been made, giving a total of 200 million barrels of 2P certified reserves. Piraña and Dorado fields have been put on stream in November 2013 and today deliver a crude production of 6000 barrels of oil per day (bopd).

Heavy crude oil is difficult to extract from the ground due to its viscosity. It does not flow like light crude and its consistency is often compared to that of molasses. Steam is sometimes injected into the oil fields to ease the flow. Alternatively, as happens at Block 67, down-hole pumps can be used to produce oils that do not flow naturally. Once out of the ground, heavy crude requires a lot of processing to be usable. Firstly to remove the water, which can make up 60 percent of the extracted material. Traditionally, this processing involves high temperatures, chemicals, large equipment and lots of time – none of which are appropriate given the environment at Block 67.

“The system is very flexible and on occasions when we get some sand or sediment in the machinery, the operator is capable of fixing the problem and getting the machine back online within two hours.”

BENJAMIN BARRAUD, PERENCO OIL

Perenco’s biggest challenge is to process the extracted material down to the 1 percent water specification required by PetroPeru before the oil can be exported. They looked at traditional methods to remove the water, such as electrostatic and chemical treatments. But such heavy technology, with a lot of requirements for space and heat, was not an option. A difficult problem to solve, but inspiration came to Perenco via an unlikely source – Hollywood.

FOLLOWING THE 2010 Deepwater Horizon spill in the Gulf of Mexico, BP spent $16m on centrifuge technology from a company represented by Oscar-winning movie star Kevin Costner.

“I was looking for something simple,” explains Barraud. “I watched a video on YouTube in which Costner demonstrated the technology. The solution was exactly what we needed to treat the heavy oil here in Peru. Almost immediately we contacted Alfa Laval due to their previous experience with centrifuge technology and quickly arranged a test using heavy crude oil at our facility in Gabon. Alfa Laval were very proactive and willing to cooperate, and the results were spectacular.”

The oil and gas industry is traditional and can be difficult to enter with new technology or techniques. It was undoubtedly a risk for Perenco to trial an unproven technology, but the results of both the trial and the initial performance of the centrifuge in Peru have been so good that Perenco has ordered two more for the other oil fields.

The Alfa Laval centrifuge – which works on the same basic principle as that demonstrated by Costner, but is otherwise a completely different technology – is at the heart of Block 67 and runs around the clock. It is operated solely by local staff with no Alfa Laval presence necessary, even for minor maintenance.

“AFTER A COUPLE OF WEEKS of testing and training, our local operators were ready to go without any assistance. They are now experts in the technology. The system is very flexible and on occasions when we get some sand or sediment in the machinery, the operator is capable of fixing the problem and getting the machine back online within two hours,” says Barraud.

The solution is a major breakthrough for both Perenco and Alfa Laval. Perenco is proud to be an early adopter of the technology thanks to the operational and economic benefits. For Alfa Laval, the successful implementation in Peru points to a bright future. By proving the centrifuge on a production site in such harsh conditions and with such heavy oil, a huge potential market opens up. ■

PERENCO WORKS CLOSELY with the regional government and local communities to improve healthcare and education in the area around Block 67. The company, the government and the communities have signed an Act of Social and Environmental Commitment and have established an open and transparent dialogue. “Today you cannot develop an oil project in the jungle as other companies did 40 years ago. Technology, mentality and responsibility have changed,” says Yván Vásquez, president of the Loreto region.

In brief: heavy crude oil

■ Heavy crude oil is highly viscous and cannot easily flow to production wells.

■ The density of crude oil is measured by API gravity, a scale from the American Petroleum Institute that measures how heavy or light a petroleum liquid is compared to water. The higher the API gravity, the lighter the crude.

■ Any liquid petroleum with an API gravity of less than 20° is considered heavy crude oil.

■ Separating oil from water is more difficult when the density difference between water and oil is low. Alfa Laval’s solution manages this without excess use of heat or chemicals.

New application for a proven technology

USING A CENTRIFUGE to separate oil and water is nothing new; in fact, it has been done for over 100 years. The technology is popular in marine environments and for producing olive oil, but it is a newcomer to the world of crude oil production.

At Perenco’s Peru facility, the main separation process consists of four stages. The free water knockout removes the bulk of the free water from the stream before being further treated. The partly dehydrated liquid is heated and de-gassed before entering the disc-stack centrifuge. Rather than rely on chemicals, the centrifuge produces between 5,000-8,000G of centrifugal force to separate oil from water in a fraction of the time of traditional methods. The denser water collects around the periphery while the lighter oil remains in the core. Both substances are removed and the process continues.

The heavy crude oil at Block 67 has an API gravity of between 11° and 16° – an extremely high density. The entire viability of the operation depends on the ability to separate the oil and water as efficiently and reliably as possible. Traditionally, the crude oil is heated to temperatures of 150°C or above, whereas the Alfa Laval centrifuge operates at a temperature of below 100°C. The energy saving of this process is significant when running 24 hours a day. Perenco reports reduced operating costs of 66 percent against the electrostatic alternative.

More traditional gravity separation devices rely on the difference in density of oil and water but are time-consuming and expensive to operate. The initial outlay for a centrifuge is similar to the alternatives, but the total cost of installation, sundries and ongoing operational costs mean a lower total cost for producers working with heavy crude oil.

A NEW WAVE OF CLEANER MARINE FUEL SOLUTIONS

First powered by the wind, then coal and then heavy fuel oil, the shipping industry is now looking for new solutions to allow it to meet the environmental demands of its customers and more stringent legislation. Alternative fuels and new technologies are part of the solution.

TEXT: **DAVID NIKEL** PHOTOS: **GETTY**

Dirty, viscous but relatively inexpensive, heavy fuel oil (HFO) has been the dominant fuel at sea since the 1960s. But changes are underway in an attempt to reduce emissions of sulphur oxide (SOx), nitrogen oxide (NOx) and particulate matter that contribute to acid rain and respiratory diseases.

The International Maritime Organization (IMO) has led the drive to move the industry away from HFO – according to Lloyds Registry, HFO will only represent about 40 percent of fuel use by 2030 – and towards fuels and technologies with less harmful effects on human health and the environment.

VESSELS OPERATING within Emission Controlled Areas (ECA) – including the Baltic Sea, the North Sea, much of the North American coastline and the Caribbean – have had to reduce their sulphur emissions to 0.1 percent from January 2015. NOx emissions will be subject to limits from 2016, while a global cap on SOx emissions is expected from 2020.

TO MEET THESE challenges, one approach is to turn to alternative fuels such as liquefied natural gas (LNG) – which is increasingly also the cargo of giant tankers, as global production and demand for this relatively clean fuel rise.

But there is a cost associated with converting vessels. Because LNG is extremely cold – about -160°C – it requires special cryogenic equipment for storage on board, fuel conditioning systems and more on-board storage capacity than conventional fuels.

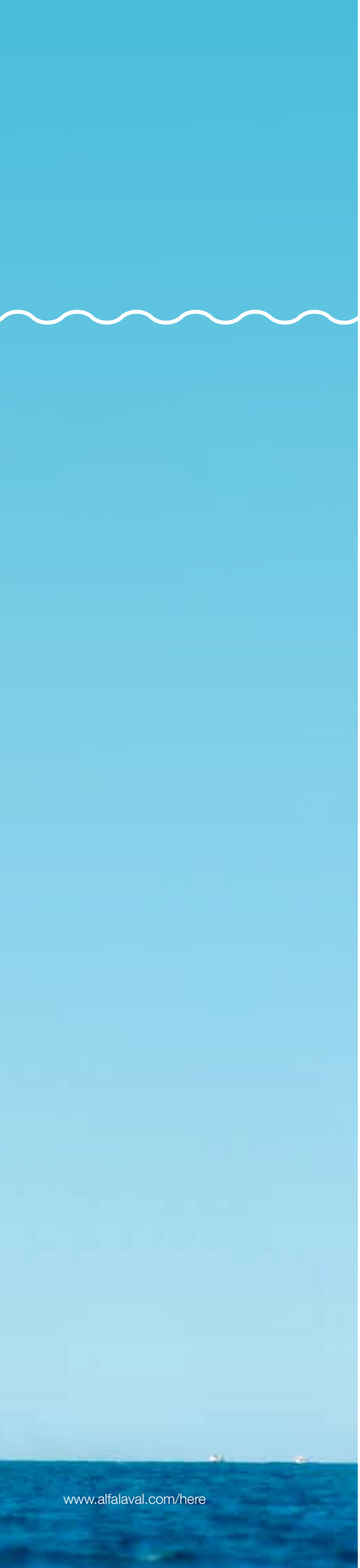
Explaining why LNG is attractive to ship-owners, Sameer Kalra, Vice President, Marine & Diesel Division at Alfa Laval, says: "The biggest advantage in using LNG is that you are always in compliance with SOx regulations as there are no sulphur emissions whatsoever. LNG also reduces NOx emissions by up to 85 percent in four-stroke engines compared to HFO. This goes a long way towards meeting the upcoming 2016 NOx regulations, besides a significant reduction in particulate matter."

While LNG, plus other alternative fuels such as methanol, fuel cells and even wind kites and solar panels can help reduce harmful emissions and meet new legislation, another approach is to use new technologies to prevent emissions from reaching the atmosphere.

SAMEER KALRA, Vice President, Marine & Diesel Division, Alfa Laval

EXHAUST GAS scrubbers remove virtually all of the SOx and most of the PM from exhaust gases, enabling them to continue operating on heavy fuel oil. According to some estimates, once a global sulphur limit comes into effect, up to 20,000 vessels could be fitted with scrubbers.

"As more stringent environmental regulations are introduced and different technologies become available, owners must consider many factors such as their vessels' trading patterns and operating profiles," says Kalra. "There will not be a one size fits all solution for the industry."



A CENTURY AT SEA

FOR NEARLY 100 YEARS Alfa Laval has been a supplier of equipment to the shipping industry. Today its extensive marine portfolio includes technologies that enable shipowners and operators to meet increasingly tough regulations on exhaust gas emissions.

Among them are the marine exhaust gas cleaning system Alfa Laval PureSOx, which has proven its worth through many thousands of hours of operation on ships worldwide.

The Alfa Laval PureSOx hybrid system can use either seawater or freshwater to clean exhaust gas. In seawater mode it can clean more than 98 percent of sulphur from exhaust gases, and in freshwater mode more than 99 percent. The system is also able to trap up to 80 percent of particulate matter.

THE SCRUBBER sprays the hot exhaust gases rising through the ship funnel with water, washing away soot and other particles and enabling clean steam to leave the funnel. The water is then cleaned with centrifugal separation, which Alfa Laval pioneered over a century ago. Centrifugal separation is currently the only cleaning method that works reliably in the rough waters in which ocean-going vessels often operate.

In another technology area, this time for LNG carriers, Alfa Laval recently acquired CorHex, the South Korea-based manufacturer of compact printed circuit heat exchangers (PCHEs). These diffusion-bonded compact heat exchangers can crucially handle deep cryogenic temperatures and high pressures far in excess of the competition. The numerous small flow channels means CorHex PCHEs take up just one quarter of the space needed by conventional heat exchangers.

THE ALFA LAVAL GAS combustion unit (GCU) is a compact system that safely disposes of excess boil-off gas, also aboard LNG carriers. The Alfa Laval GCU has proven capabilities to burn gas mixture with high nitrogen content in a safe way, ensuring the disposal of all methane gas without requiring the use of pilot oil burners. It provides shipowners with gas combustion technology that is easy to integrate, reliable to operate and easy to maintain.

EEDI: **Efficiency designed in**

Shipping in the most efficient form of commercial transport, in terms of CO_2 emissions per tonne of cargo. But faced with high fuel costs, increased environmental awareness and increasing emissions legislation, the industry has pledged to make the global fleet even more energy efficient.

The Energy Efficiency Design Index (EEDI) is a new International Maritime Organization strategy aiming to bring about long-term change in ship design. The formula contains measures that can achieve notable reductions in fuel consumption and CO_2 emissions. By 2030, the IMO aims to reduce the amount of annual CO_2 emissions by between 180 and 240 million tonnes.

COOLING THE INTERNET

How much time do you spend on the Internet or on social media each day? At work or in your spare time? For most of us, these are now vital parts of our lives. With data centres literally running hot to keep up with the demands for smooth traffic and enough storage space, the business for server room cooling is getting very lucrative indeed.

TEXT: **ULF WIMAN** PHOTOS: **GETTY** ILLUSTRATION: **PETTER LÖNEGÅRD**

We see it, we want it, and – in some cases – are dependent upon it. Ever-evolving technology and design updates are incessantly tempting consumers to get the latest gimmicks.

The extraordinarily increasing use of mobile devices has skyrocketed Internet use to completely new stratospheres, as we can now be online 24/7, bringing Internet with us everywhere. Our work life depends on it, as does our personal life. We communicate and connect through e-mail and social media, read news and blogs and get information on every imaginable subject, watch movies and sports, listen to music, do our banking as well as store our pictures and music in the cloud. The list goes on. And on...

After a notable surge in the mid-nineties, there were around 413 million Internet users in the world at the turn of the century according to the often-cited statistics provider Internet Live Stats. World population penetration – though very unevenly distributed – was 6.7 percent. The first billion users was reached in 2005, the second in 2010 and now, in 2015, the number is more than 3 billion and counting. The global penetration has passed 40 percent. In many countries, the penetration rate is getting close to 100 percent.

> **“It is easy to believe that a server room is cool, but in fact it is warm and cosy.”**
>
> MATS CARSELID, GLOBALLY RESPONSIBLE FOR DATA CENTRE COOLING SOLUTIONS WITHIN ALFA LAVAL.

These numbers are stunning, but few of us stop to think about what actually makes it all tick. Behind the scenes, it takes an intricate infrastructure comprising a lot of software and hardware, such as servers, storage, network devices, switches and routers, not to mention cables, to handle the staggering amounts of bytes that we produce and store globally each second.

TO MEET THE GROWING challenge, data centres of all sizes have sprung up all around the world – from small to mega – including flexible/containerized and stationary data centres, and of all data centre tiers, from the simplest tier 1 to the high-safety cutting-edge tier 4.

Managing data centres is a fast-growing niche market, and while the numbers vary greatly, one source mentions a 15-percent yearly growth. The uncertainty is in part a result of the hush-hush nature of the business. Due to the absolutely crucial nature of the operation, security and reliability can never be put at stake. Thus data centres are typically windowless, anonymous and closely guarded secrets. Many major Internet players don’t disclose how many data centres they have or their location. It’s part of the game to just share the lowest level of information.

Did you know that, each second, around the world...

- **2,160** photos are uploaded to Instagram
- **9,300** Tweets are sent
- **49,000** Google searches are done
- **102,000** YouTube videos are watched
- **1.4 billion** people are active on Facebook
- **115** billion emails are sent.

THE OPERATION for example requires fail-safe cooling, humidification, air handling, power distribution and backup systems for the backup systems. On the downside, data centres consume huge amounts of energy. According to the American magazine Time, the digital economy uses a tenth of the world’s electricity and one single data centre may use enough electricity to power 180,000 homes. Consequently, energy efficiency is a top priority for data centre operators. All the electronic equipment generates lots of heat, which makes server room cooling a major energy thief.

WITH AN 18-PERCENT annual growth, the data centre cooling market grows even faster than the data centre market. Some 99 percent of all servers are air-cooled, of which CRAC units (Computer Room Air Conditioning) make up about 80 percent. In-row coolers and heat wheels (Kyoto wheels) are other variants to blow air on the servers. There are also liquid-cooled solutions and while these are currently in minority, some solutions, such as the liquid cooling technology of Alfa Laval partner Iceotope (for more information, see Here 32), has shown great promise and may increase in use in the future.

“It is easy to believe that a server room is cool, but in fact it is warm and cosy,” says Mats Carselid, who is globally responsible for data centre cooling solutions within Alfa Laval. “The ideal temperature for a server rack is between 22 and 25 centigrade. If it is too cold, there will be condensation and static electricity on the components; too warm and you risk overheating.”

Behind the server rack the air is typically 10 degrees warmer after passing the electric components, before the air is returned to the CRAC unit via an upper plenum. It takes a lot of air to cool the servers.

It stands to reason that data centres make money from servers, not coolers, so the demand is for small units that take up as little space as possible. But with a small unit, there is only one way to move all the air needed to cool the servers – you accelerate it. To cool a middle-sized data center of 1MW – equivalent of what it takes to power approximately 1,000 homes – an airflow of 70 m3/s is needed, given a temperature difference (delta T) of 12 degrees.

THIS WOULD BE FINE, if it was not for the so-called Venturi effect. This natural law of physics basically explains that when the air speed is increasing above 1.5 to 1.8 m/s, the air pressure is going down. A good example is the geometry of an airplane wing, where the air is split in front of the wing, making some of the air go above and some below the wing. The air going above the wing will be accelerated and air pressure is going down on the upper part of the wing, giving lifting power.

"This is exactly what happens in a CRAC-cooled data centre," Carselid explains. "Due to the fast-streaming air you get pressure variations in the server room. Consequently, you'll have areas with little or no cooling, so-called hotspots."

This is a well-known issue in the data centre business. In pressurized data centres with CRAC units, the operators are often well aware of where the hotspots are and have come up with solutions that work, but monitoring and control can get very complicated.

THE HOTSPOT PROBLEM is usually solved by creating overpressure in the CRAC unit. However, due to air leakage through, for example, doors and joints, you need to blow more air. And this sets the snowball rolling, and the kW consumption spinning. Another pressure factor is to not design the data centre with too narrow aisles, as this may force the airflow to accelerate, creating overpressure.

Adding to the challenge, servers are dynamic over time. For example, a dedicated financial server is extremely busy at the end of the month, maybe peaking three days each month. In the rack next to it may be a gaming server, which gets busy when people come home from school and work in the afternoon and evening. Next to that, there might be a backup server, which works hard between midnight and three in the morning, but is otherwise idle. A data centre seldom works at full capacity, usually about 60 percent.

To address the hotspot and pressure problems, Alfa Laval and Dutch partner Boersema Installatie Adviseurs, BIA, have come up with an unorthodox server room solution, LSV (Low Speed Ventilation), which contrary to common wisdom uses a larger air-cooling unit, the Alfa Laval Arctigo LSV.

"WITH THE LSV, we size and dimension a heat exchanger that is big enough to handle the task,

SLOWING DOWN TO GET AHEAD

Here met up with airflow mastermind Kees Boersema of Dutch company Boersema Installatie Adviseurs to get the history of low-speed ventilation (LSV) and find out what lies ahead.

How did you come up with the idea for LSV?

"A couple of years ago we noticed that our approach to airflow differed fundamentally from the traditional way, which is to force air through the data centre, typically leading to pressure differences and high energy consumption. We realized that pressure, high air speeds and hotspots were related physical phenomena that could be prevented with a different air circulation pattern."

At what point did you realize that the idea could take off?

"The design with low air speeds and hardly any pressure differences not only decimated the energy consumption – it also increased data centre reliability and improved maintenance, fire suppression, noise control, personnel comfort, tier reliability and IT hardware lifetime."

How and why did you hook up with Alfa Laval?

"We had positive experiences with Alfa Laval and contacted product manager Ad Boiten to discuss our requirements for a robust, industrial-quality low-speed ventilation air cooler with a large cross-sectional area. Together with Ad we specified and designed the air cooler, which is easy to move, has optional filters, step-less control, and is durable and almost maintenance-free."

What is next for LSV?

"Additional advantages often fit in naturally with inherently good designs. The slow-moving air and large cross-sectional area make the heat transfer very efficient. After a year-long study, financed by the Dutch government, we successfully developed steering algorithms to further increase the temperature of the air cooler water side, which defines the effectiveness when reusing heat generated by a data centre. This adds sustainability to reliability, durability and energy-efficiency." ■

The lowdown on low-speed ventilation

CRAC units

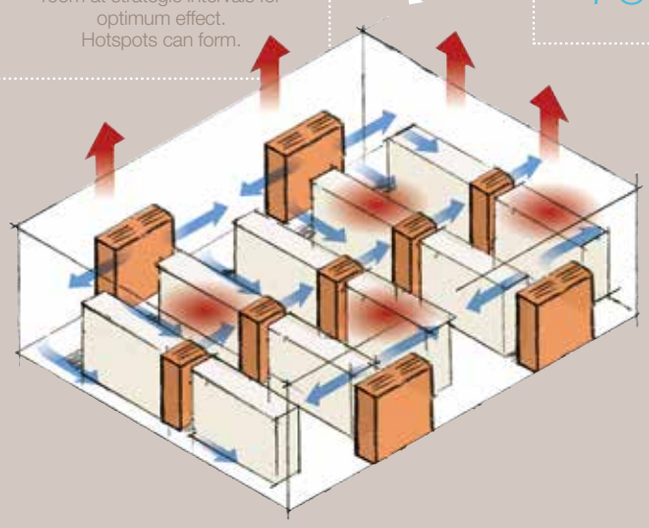
CRAC (Computer Room Air Conditioning) is currently the most common server room cooling technology. The units are placed inside the server room at strategic intervals for optimum effect. Hotspots can form.

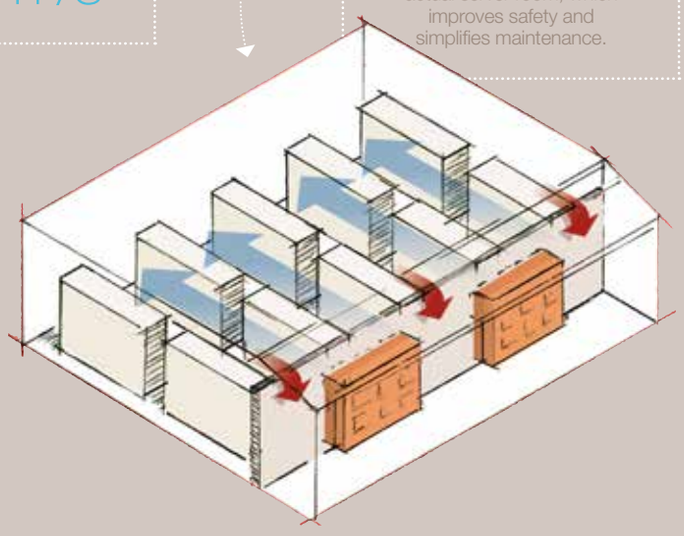
Airflow

70 m³/s

LSV

LSV (Low Speed Ventilation) is a new, competing technology where the air cooler units are placed outside the actual server room, which improves safety and simplifies maintenance.





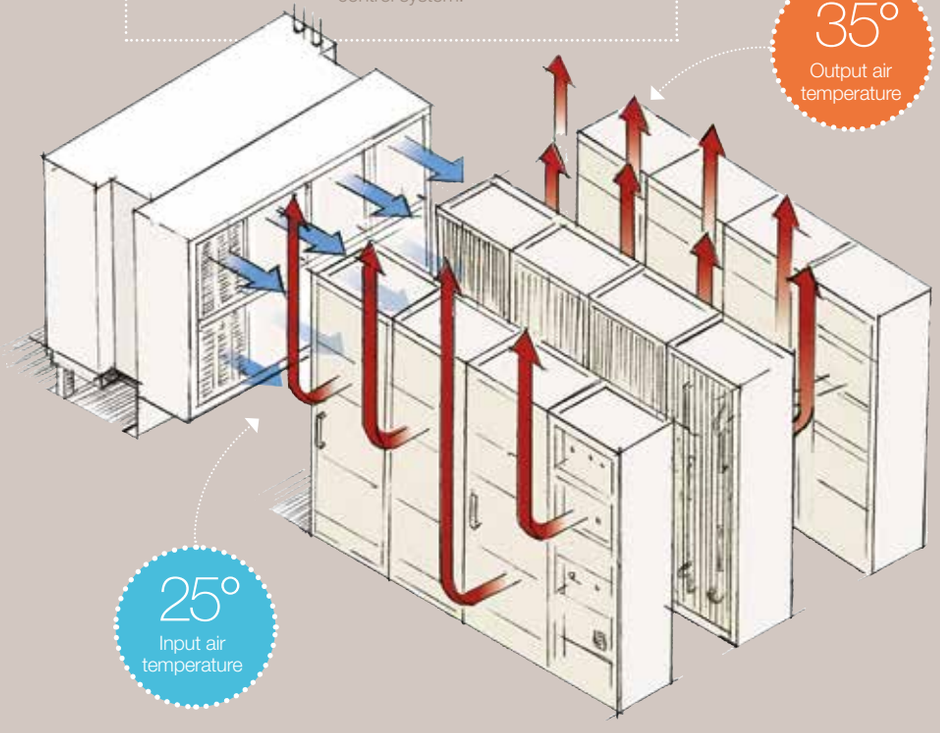
LSV - Low Speed Ventilation

Alfa Laval Arctigo LSV air coolers are specifically designed for server room cooling. They operate with low fan speed, low air velocities and minimal pressure differences along the route of the airflow, providing a simple, stable and reliable climate control system.

The Venturi effect

The so-called Venturi effect explains why an airplane can fly. The geometry of an airplane wing splits the airstream, so that the air going above the wing will be accelerated and air pressure is going down on the upper part of the wing, giving lifting power.

35°
Output air temperature



Airspeed

1.8 m/s

The threshold above which the Venturi effect kicks in, causing the air pressure to drop.

25°
Input air temperature

“The ideal temperature for a server rack is between 22 and 25 centigrade. If it is too cold, there will be condensation and static electricity on the components; too warm and you risk overheating.”

MATS CARSELID, ALFA LAVAL.

without hitting the Venturi effect,” says Carselid. “This way we get a normal pressure in the entire room, still delivering the required amount of air. We don’t have to worry about the pressure at all, which is a totally new way of thinking. In an LSV-cooled data centre, the air availability is controlled, not the air pressure. And that’s a completely different task to do; much easier and cheaper as it requires less controlling equipment.”

With several installations so far the concept is proven, but as in any business, a technology shift within the server room cooling business will take time. But the advantages of LSV are hard to ignore.

Measuring effectiveness in a data centre can be done by the so-called PUE value (power usage effectiveness), which preferably should be as close to 1.0 as possible. “PUE is a rather blunt method, but still a value the data centre industry speaks about,” Carselid says. “It measures the fraction between total facility energy and IT equipment energy. The kW contributors are servers, battery backup systems, cooling, lighting, security, power distribution etcetera.”

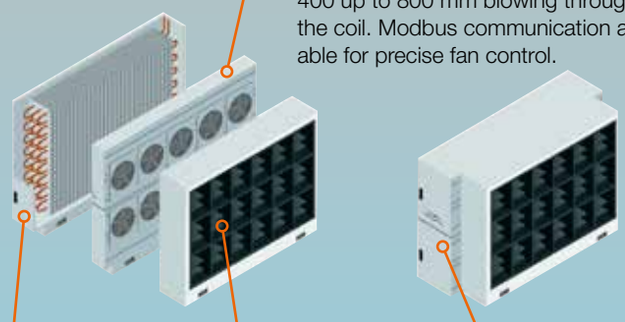
THE COOLING PART is a large part of the total energy, especially if the data centre is using mechanical (chiller) cooling. The effects of using free cooling are great and for that reason some data centres are developed in remote areas with low ambient temperatures.

“The PUE value for the LSV technology is as low as 1.07 with the use of outside air in a Western European installation. This is ground-breaking as the mean PUE value for non-LSV data centres is 1.5,” Carselid explains.

For sure, as the data centre segment keeps growing, the cooling solutions will get more and more effective as well as environmentally friendly. When posed with the questions how much the data centre business can grow and when the curve will break, Carselid is quiet for a moment, then answers thoughtfully: “The server room cooling business is something totally unique,” he says. “The growth curve points right up and the general opinion is that when it breaks we will be in the middle of a complete technology shift – such as when we moved from horses to engine-driven vehicles – where we maybe don’t need servers, or we use another kind of server. No one really knows, but it will be a fantastic journey.”■

Innovative data centre cooling solutions

Alfa Laval Arctigo LSV (Low Speed Ventilation) air coolers are heavy-duty industrial air coolers specifically designed for server room cooling. LSV air coolers operate with low fan speed, low air velocities and minimal pressure differences along the route of the airflow. The units are also placed outside the server room, which simplifies maintenance and keeps security high.
Alfa Laval Arctigo LSV units are available in sizes from 1,115 to 6,515 millimetres (length) and 880 to 2,700 millimetres (height). Refrigerant water. Nominal capacity 7.4 to 311 kW. Air volume 1,865 – 77,750 m3/h.
Alfa Laval also supplies most of the upstream equipment used for data centre cooling systems, regardless of the actual server room solution, including pumps and heat exchangers. The company has a proven track record in free cooling solutions using outdoor air or water. For air these include adiabatic coolers, dry coolers and cooling towers, but an LSV system can even use direct outside air, which reduces the operational costs even further. ■



EC FANS
1 to 10 energy-efficient EC fans, Ø 400 up to 800 mm blowing through the coil. Modbus communication available for precise fan control.

FINNED COIL
Made of heavy-duty industrial-quality corrugated aluminium fins and copper tubes, the modular cooler coil is the heart of the unit.

F9 FILTER UNITS
Easy-to-replace filter units cover the entire coil surface area, which simplifies cleaning and inspection.

CASING
All casing parts are made of corrosion-resistant material with a heavy-duty epoxy finish for easy cleaning and minimal maintenance.

Low speed ventilation benefits:

- Extremely low energy consumption, up to 35–40% lower compared to conventional technology.
- Substantial operational cost reduction
- Simple, stable and reliable climate control system
- No cooling equipment in white space (usable floor space)
- Easier implementation of free cooling
- No “hotspots” caused by high air speeds
- Better white space working environment.

The sweet taste of success

Growing middle class fuels chocolate boom in China

TEXT: **JAN HÖKERBERG** PHOTOS: **GETTY**

Chinese culture is a gift culture, where important meetings are made auspicious by the exchange of gifts. With the growth of the Chinese middle class and its taste for premium products, this has led to a boom in demand for premium chocolate.

In China, chocolate is regarded as a foreign product and most consumers had never even tasted chocolate until it was launched in the mid-1990s, when new modern air-conditioned hypermarkets and supermarkets started to meet the international confectionary industry's requirements for chilled storage and distribution channels.

Today, the Chinese market for chocolate and sugar confectionary has become the second largest in the world after the United States. The local chocolate market has been growing by 12 percent annually. China's embrace of chocolate has even pushed up cocoa prices and contributed to fears of an international shortage.

Most of the premium chocolate sold in China is used for gifts or for ceremonial purposes such as weddings. Chocolate is sold as a high-class food product and luxury packaging adds to its status.

The Chinese chocolate market is dominated by foreign-owned companies that have set up factories and started to acquire local competitors. One of them is Italy-based Ferrero Group, the third-largest chocolate producer in the world, whose gold foil-wrapped spherical chocolates have a special appeal in China, where gold symbolises wealth.

Alfa Laval, which has long been a supplier of food processing equipment and cleaning solutions to the international chocolate industry, recently supplied Ferrero with a large number of pumps for its Chinese production facility. They offer lower operating costs, because of improved durability. ■

Chocolate in China

■ Chocolate sales in China grew 58 percent from 2009 to 2013. They are expected to rise to USD 4.3bn by 2019, up from USD 2.7bn in 2014.

■ Chocolate producers in China need to import cocoa, cocoa butter, cacao paste, sugar and dairy products.
South China is the largest confectionery-manufacturing base in China.

■ The peak seasons for chocolate purchases are concentrated around holidays – in particular Chinese New Year, which falls in January or February.

Three questions

to Jan Debruyn, President, Alfa Laval China

What are your expectations for the growth of the chocolate market in China?

"I expect it will grow continuously over the coming ten years, thanks to rapid urbanisation, increasing incomes and a growing middle class, which will lead to more Chinese adopting high-consumption lifestyles and spending more money on food and beverages. In addition, Chinese people have changed their consumption behaviours and are willing to pay a premium for quality and not just basic necessities."

How are the tastes of Chinese consumers changing?

"The changes in taste and food consumption have been taking place since the early 1980s and have been significant both in terms of the amount of food consumed and in the composition of foods consumed.

"As per-capita income has increased, there has been a marked decline in per-capita consumption of grains, while the consumption of seafood and animal products such as meats, eggs and dairy products has increased steadily."

What does the Ferrero deal mean for Alfa Laval?

"Chinese consumers increasingly have a taste for quality, and we help our customers by creating premium choices that generate higher customer prices, such as premium beers or specialty oils. Alfa Laval's core technologies and competencies are a good fit, as the Chinese food market moves in the direction of more 'premium' products, prepared food, and efficient and safe production processes."

A FOCUS ON QUALITY AND ENERGY EFFICIENCY

Japanese shipbuilder SHI-ME deepens cooperation with Alfa Laval as it pursues strategy to provide high-quality, high-performance products.

TEXT: **CHAD HENDERSON** PHOTO: **SHI-ME**

Japan remains one of the world's top three shipbuilders, in competition with South Korea and China. According to IHS World Shipbuilding Statistics, in 2014 Japan completed 522 ships (of 100 gross tonnage and over), while South Korea completed 341 and China 906. In order to give the company a competitive edge, Sumitomo Heavy Industries Marine & Engineering Co., Ltd (SHI-ME) has developed a strategy that focuses on producing high-quality, energy-efficient ships. As part of this strategy, SHI-ME recently deepened its cooperation with Alfa Laval.

SHI-ME IS A LEADING producer in Japan of general-purpose, medium-sized Aframax tankers, which are suitable for voyages of different lengths. During the last ten years SHI-ME has delivered more than 60 medium-sized tankers to the market, and the company has back orders for the next two years.

"Korean and Chinese shipyards have higher

market share, but SHI-ME's strategy is to provide higher-performance and high-quality products," says Akihiro Shirai, General Manager, Purchasing Department, at SHI-ME's Construction Management Division. "It is also essential that we provide the best solution for meeting legislative requirements for ballast and emission controls."

One way SHI-ME improves the fuel efficiency of its ships is to focus on improving propulsion efficiency. Every design parameter is examined, including hull structure, the propeller model and the main engine. SHI-ME works closely with its suppliers to find the best total propulsion system to meet the desired efficiency level.

"SHI-ME also needs to use highly energy-efficient components in the engine room," says Shirai. "We work with suppliers who can offer a total energy-saving solution, such as a high-performance boiler that has a smaller footprint and installation volume."

SHI-ME has been using Alfa Laval Aalborg products in its engine rooms for a number of years, including an auxiliary boiler, which efficiently produces steam for the engine room. To save energy, the company also uses an exhaust gas economizer, which uses exhaust gas from the engine to produce steam.

"Alfa Laval is a trustworthy and reliable supplier, backed by the history of our long relationship, which started with Aalborg Industries in 1967," Shirai says.

When SHI-ME began looking for suppliers for its new Aframax tankers, Alfa Laval invited the company to tour its factory in Shonan for gasketed plate heat exchangers.

AS A RESULT of several meetings, and the factory tour, SHI-ME decided to use Alfa Laval's gasketed plate heat exchangers in its upcoming Aframax vessels. The heat exchangers are designed to increase efficiency, lower energy, and minimize impact on the environment.■

Akihiro Shirai: 'We work with suppliers who can offer a total energy-saving solution.'

Alfa Laval celebrates 90 years in Japan

A traditional sake barrel lid-breaking ceremony at the 90th anniversary celebrations.

Ninety years ago, Alfa Laval's high-speed separator was first introduced to Japan for use in dairies. Since then, Alfa Laval Japan has strived to be a valuable partner to its customers in a wide variety of industries, including marine and diesel, HVAC, service, food, pharmaceutical and process industries.

"Everyone at Alfa Laval Japan, past and present, can be proud to be part of this long and successful history," says Managing Director Richard Kelly. "We have served our markets well and will strive to be our customers' number-one choice in the years ahead."

The company is also celebrating the 20th anniversary of the opening of it plate heat exchanger factory in Shonan. More recent milestones include Alfa Laval's integration four years ago with Aalborg Industries, a key business in the marine market, and the group acquisition last year of Framo, previously known as Frank Mohn, a long-established key supplier to the marine industry. ■

Avs:
Alfa Laval Nordic AB
147 80 Tumba

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SVERIGE
PORTO
BETALT

Back to the future

Soy sauce.
Long a key ingredient in oriental cooking, soy sauce is today also a regular feature on Western dining tables.

It was first produced in China in the 5th century BC, and today the country turns out some 5m tonnes of soy sauce a year – that's more than half the total global output. Perhaps unsurprisingly, production methods are still traditional and labour intensive.

Enter Alfa Laval. Our cutting-edge separators and evaporators help soy sauce producers modernize and streamline their manufacturing processes. Processing time can be substantially reduced and energy saved, cleaning becomes easier, and hygiene is improved.

All this adds up to refined quality.

It is no wonder that seven of the ten main Chinese soy sauce producers have implemented our technology. Taking them back to the future.

ALFA LAVAL

www.alfalaval.com