NO. 28
AN INTERNATIONAL MAGAZINE FROM ALFA LAVAL

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here

LIFE SCIENCES
Technology the key in the search for cancer treatments

BIOFUEL
Fuel from waste – a luctrative business

COMBINING HEAT AND POWER
Making the most of nature's resources

"Water ballast treatment will help us and the next generation keep our oceans fresh and clear. My crew and I want to see the Earth in green and blue, not grey."

Konstantin Bukhantsev, *captain of the* JRS Brisbane, *which uses the Alfa Laval PureBallast system.*

flourishing REFRIGERANTS

The world has reached an important crossroads. With technology in place for naturally occurring refrigerants, it's up to the industry to choose the most environmentally sound path.

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Meeting tomorrow's concerns

editorial Almost a year has passed since world leaders met in Copenhagen in December 2009 to discuss environmental concerns. The discussions were essential in driving development towards deeper awareness of and innovative solutions to both current and future environmental problems.

In the '70s we became aware that the coolants in our refrigerators leaked and severely damaged the ozone layer. Today, due to a joint effort in banning the use of the harmful chlorofluorocarbon gases (CFCs), a common refrigerant of that time, the ozone layer is gradually repairing itself. However, the solutions we have used since are not optimal; now we need to shift to more natural refrigerants that don't add to global warming.

EARLY ON Alfa Laval was involved in the development of new solutions based on three common natural refrigerants: ammonia, hydrocarbons and carbon dioxide (CO_2). These refrigerants put new demands on equipment. For instance, the use of CO_2 requires refrigeration systems to operate at more than five times the normal pressure of a classic refrigeration system. Alfa Laval has developed a full range of heat exchangers to cope efficiently with these high-pressure systems. Today, several Scandinavian and UK supermarket chains are using CO_2 as a standard solution.

Other natural refrigerants are also being employed in real-life solutions. In this issue of *here* you can read about how ammonia is used as refrigerant in a district cooling system in Copenhagen.

HARMFUL EMISSIONS can also be found at sea. The International Maritime Organization strives to reduce the environmental impact from the shipping industry. IMO has formulated conventions for ballast water treatment systems and has declared its goal to cut air pollution from sea transport by as much as 80 percent by 2016.

Also in this issue you can learn about our PureBallast system, the chemical-free solution for ballast water treatment, and how it works onboard the freighter *JRS Brisbane*. You can also read about two pilot projects to cut down sulphur oxide and nitrogen oxide emissions from ships, in which Alfa Laval has teamed up with two big players to develop and evaluate new pioneering solutions to address this global issue.

So with the COP16 coming up in Mexico in November 2010, we can say that there are still things that need to be done – but there are definitely concrete solutions already in place. And that is a good thing for the future.

SUSANNE PAHLÉN ÅKLUNDH
EXECUTIVE VICE PRESIDENT,
HEAD OF EQUIPMENT DIVISION

New virtual showroom worth a visit

Alfa Laval is inviting the public to a new virtual showroom located at alfalaval.com. The showroom, due to open by the end of 2010, will showcase the company's newest and most exciting product innovations. It will start off with half a dozen products and will be updated with new products over time.

Peter Torstensson, vice president, Communications, at Alfa Laval, says, "The new virtual showroom will give visitors a fantastic introduction to some of our most exciting new products that use cutting-edge technology. The experience we had with our previous showroom was that it was highly appreciated by customers and colleagues throughout the world. People in general have been hoping for a comeback of the showroom."

Amongst the products in the showroom will be spiral heat exchangers with a built-in self-cleaning capability to reduce the need for cleaning to once every five years (from the annual cleaning needed with the shell-and-tube heat exchangers). Spiral heat exchangers deliver three times the heat transfer but require only 16 percent of the space of a comparable shell-and-tube installation.

The new ALDEC G3 decanter will also be on display.

DID YOU KNOW THAT...
...Alfa Laval started its first sales company in the United States in 1885 and in 2010 is celebrating 125 years in that country.

Greener vodka

Russia is one of a number of countries where regulations for distilleries are toughening up due to stricter environmental laws.

As of 1 January 2010, vodka producers in Russia are required to clean and take care of the residue from vodka production instead of pumping it out into nearby lakes and seas, as was the common practice in the past. A solution from Alfa Laval is helping the Urzhumsky distillery in Kirov with this process and generating revenue from the residue at the same time.

This large producer of alcohol has some 80 different types of vodka in its product range. For every litre of alcohol that is produced, 10 litres of residue are created. Since the distillery has the capacity to produce up to 25,000 litres of alcohol per day, that adds up to a potential 250,000 litres of residue daily.

The Alfa Laval solution, which includes decanters and evaporators, handles the residue-processing task by directing the residue into a decanter centrifuge where solid particles are separated from the liquid. The liquid portion is then directed into an evaporator where it is cooked, concentrated and dehydrated before being mixed with the solid particles. This remaining dry mass – comprising fibres, yeast and proteins – is sold as animal fodder for about 110 euros per tonne.

ALDEC G3 decanter – an efficient performer

Alfa Laval has once again raised the bar in sludge dewatering. The recently launched ALDEC G3 decanter reduces the total power consumption by up to 40 percent, compared with current decanter technology.

The decanter centrifuge is built around the ground-breaking Slimline design, featuring a smaller conveyor diameter, which enables an increase of up to 10 percent in sludge-processing capacity.

47,500 tonnes CO_2

This is how much an average refinery can reduce its emissions by replacing traditional shell-and-tube heat exchangers with Alfa Laval Compabloc 120.

Supporting the panda

In support of the WWF's Panda Project, Alfa Laval has donated more than 5,000 trees to be planted in China's Minshan Mountains. The trees will be planted in the Sichuan Province, where the giant panda lives. They are essential to the restoration of this area, which was severely damaged during the May 2008 earthquake.

The area is unique, comprising coniferous forests and a diverse floor vegetation, including bamboo, which is important for many animal populations. In addition to the giant panda, the area is populated by black bear, brown bear, lynx, the clouded leopard and the golden monkey – a species only found in the panda's habitat.

Partners in wind

By signing a five-year purchasing agreement with Vestas, a world leader in wind turbine manufacture, Alfa Laval has taken a giant leap into the fast-growing wind power industry. The agreement means that Alfa Laval will be a recommended supplier of oil-cooling equipment to all Vestas' projects for the next five years. The agreement has an estimated total value of about 150 million Swedish kronor (15.6 million euros).

Vestas has some 15,000 wind turbines installed around the world, which represents about 20 percent of the world's total capacity.

Oil coolers are an important part of a wind turbine, ensuring that the turbine gearbox runs smoothly year after year. If the oil overheats, it could severely damage the gearbox.

Vestas and Alfa Laval have cooperated closely on the oil cooler design to ensure a perfect fit. Being a partner to the wind power industry presents an increasing number of opportunities. Today wind power represents about 1.3 percent of the world's total electricity output, but the International Energy Agency predicts that by 2030 some 2,500 gigawatts or 17 percent of the world's electricity consumption will be generated by wind power.

"This is an exciting opportunity for us to further strengthen our relationship with Vestas," says Lars Renström, president and CEO of the Alfa Laval Group. "It also proves our ability to supply energy-efficient solutions."

One stop shop for biopharm facts

Alfa Laval has stepped up its service to the biotech and pharmaceutical industry by launching a new web portal packed with information, documentation and education.

The portal, located at *www.alfalaval.com/biopharm*, contains a summary of Alfa Laval's engagement in the industry as well as a complete overview of equipment intended for biotech and pharmaceutical companies, including separators, membranes, heat exchangers, pumps, valves, tubes, fittings, tank equipment and the Alfa Laval ART Plate Reactor.

Portal visitors can download all documentation needed for the certification and validation of Alfa Laval's UltraPure products as well.

In addition, the web portal features films, including animated films, to provide insight into various products or processes while looking at how innovation, process knowledge and hygienic design create value for the industry. These mini seminars, from three to six minutes in length, are also available on YouTube.

www.
alfalaval.com/
biopharm

More power for engine builders

Thanks to the acquisition of the US company Champ Products in early 2010, Alfa Laval has stepped up its offer of product and application expertise for cooling, filtration and crankcase gas cleaning of diesel and gas engines.

This means engine builders worldwide can turn to Alfa Laval for extensive engine knowledge and access to unique and innovative products. Alfa Laval offers customized solutions for the recreational and commercial marine, on- and off-highway, locomotive and light manufacturing industries as well as for stationary power generation systems.

The portfolio includes a variety of heat exchangers along with the Eliminator Filter, an optimized lube oil treatment solution, and the Alfdex and PureVent oil mist separators for cleaning crankcase gases.

Champ has been recognized for its deep knowledge of engine cooling and perceived as a leading company in the North American market.

Packinox during transport.

Elevated efficiency

As investments in energy efficiency soar, demand for Alfa Laval's compact heat exchangers – particularly the unique Alfa Laval Packinox – is growing.

In 2011, the largest Packinox heat exchanger ever will be delivered to a refinery in India, where it will be used in a catalytic reforming unit for the production of gasoline. The heat exchanger is 25 metres tall, the largest Alfa Laval has built so far.

The order was placed in the first quarter of 2010 and is valued at 95 million Swedish kronor (9.7 million euros).

Refrigerants: NATURE'S OWN

A few decades ago, the world began drastically reducing the use of refrigerants that depleted the ozone layer. Their replacements, however, turned out to be potent greenhouse gases. While the world is considering whether to phase out these harmful substances, consumer groups and industry are finding naturally occurring refrigerants to be a cost-effective and long-term solution.

TEXT: **JACK JACKSON** ILLUSTRATION: **ANNIKA SKÖLD**

WHEN SCIENTISTS DISCOVERED a link between the coolant in refrigerators and a growing hole in the ozone layer in the 1970s, people around the world found the concept difficult to accept. How can the one really affect the other? But over time the reality became increasingly clear: chlorofluorocarbon gases (CFCs) – commonly used as a refrigerant at the time – leaked out of refrigeration systems and rose to the stratosphere, breaking down large amounts of ozone. With less ozone there, harmful ultraviolet-B radiation was reaching the earth's surface, increasing the risk of cancer and other genetic damages in animals and plants. When evidence emerged that the "ozone hole" was growing steadily, world leaders took action.

In 1987, delegates from 43 nations signed the first version of the Montreal Protocol, beginning a phase-out of CFCs and other substances that depleted the ozone layer. This included hydrochlorofluorocarbons (HCFCs), another common refrigerant. By 1999, 196 states had ratified the protocol on substances that depleted the ozone layer.

"The world agreed to get rid of these substances," says Rajendra Shende, head of the OzonAction Branch of the United Nations Environment Programme. "The Montreal Protocol is considered by most policy experts to be the most successful environmental treaty ever agreed. It is the only international treaty to have every country in the world as a signatory, and it has reduced the production and consumption of 96 ozone-depleting substances by 97 percent."

By the beginning of this year (2010), CFC production and consumption had stopped entirely, and several countries had begun a phase-out of HCFCs. Ongoing scientific measurements sponsored by the United Nations Environment Programme are finding that the ozone layer is starting to slowly repair itself. With the end of one problem, however, a new one has begun.

The refrigeration sector has mainly replaced its ozone-depleting refrigerants with hydrofluorocarbons (HFCs) – another of the synthetic fluorinated gases termed "f-gases".

While HFCs do not affect the ozone layer, they are devastating greenhouse gases. The most popular HFC – known as HFC 134a, mainly used in domestic refrigeration and vehicle air conditioning – is around 1,500 times worse in its effects at warming the planet than CO_2.

> **"If the 300 grams of HFC in your domestic refrigerator at home were released into the atmosphere, it would have the same impact on the climate as the carbon emissions from driving a Volkswagen Golf from London to Moscow."**
>
> RAJENDRA SHENDE, UNITED NATIONS ENVIRONMENT PROGRAMME

"If the 300 grams of HFC in your domestic refrigerator at home were released into the atmosphere, it would have the same impact on the climate as the carbon emissions from driving a Volkswagen Golf from London to Moscow [about 2,500 kilometres]," Shende says.

HFCS COME IN DIFFERENT forms, however, each with different climate impacts. For example, HFC 23 is more than 14,000 times more forceful than CO_2 as a greenhouse gas, Shende says.

HFCs are included in the "basket" of greenhouse gas emissions that are part of the net emission targets of the

Kyoto Protocol, but for groups wanting to eliminate rather than limit HFCs, this is not enough. In November 2010, the parties to the Montreal Protocol will meet to discuss whether they want to take on the responsibility of phasing out HFCs, Shende says. If they agree, then it must be ratified at the upcoming United Nations' COP 16 conference on climate change in Mexico in December. "Allowing the Montreal Protocol to control HFCs could arguably lead to a much quicker phase-down of these chemicals," he says.

"Obviously, HFCs do not seem to be the solution for a new refrigerant, unless there is no other alternative," says Shende. "It happens there are other alternatives."

Natural refrigerants are friendly to both the climate and the ozone layer. They occur naturally in the environment and include ammonia, hydrocarbons and CO_2. While each has obstacles in a refrigeration setting, modern technology makes it possible to find efficient, economical long-term solutions (see box on page 10).

Natural refrigerants are most common in domestic refrigeration. In 1992, Greenpeace pioneered a hydrocarbon technology known as Greenfreeze, using isobutane as a refrigerant. Greenfreeze now makes up 36 percent of the global domestic refrigerator market, with more than 400 million units around the world, including in China, India and Brazil.

The use of natural refrigerants is also expanding in supermarket refrigeration and room air conditioning, but not yet on as big a scale as on the domestic refrigerator market.

MEANWHILE SOME countries are phasing out or banning HFC-based systems, challenging manufacturers to invest in other solutions. Denmark is doing this, for instance. In addition Denmark and Norway also tax f-gases to encourage companies to move more quickly to natural refrigerants. The UK is pushing a legislative effort to ban HFCs in supermarkets, and the EU is targeting the vehicle air-conditioning sector with the most comprehensive legislation dealing with HFCs, says Shende. From January 2011, the refrigerants used in this sector will have to be less than 150 times more forceful than CO_2 as a greenhouse gas, compared with 1,500 times more powerful for the HFC currently in use.

The Montreal Protocol also includes the Multilateral Fund, a financial mechanism that helps developing countries comply with their commitments by funding incremental costs of projects to phase out ozone-depleting substances. Shende says, "The fund is now scaling up the number of demonstration projects using natural refrigerants and other ozone- and climate-friendly chemicals in order to build up data on the viability of large-scale projects. Hopefully this will encourage an increase in their use in developing countries."

For instance, in China, which is the largest manufacturer and consumer of HCFC products in the world, the government and the refrigeration industry teamed up in 2010 under the Multilateral Fund to start two pilot projects to study the effects of replacing HCFCs with ammonia and CO_2.

The US Environmental Protection Agency has just allowed hydrocarbons to be used in domestic refrigeration and small commercial refrigeration, says Shende. "This is a huge step forward, because until then the US was the only major economy not to have allowed their use."

BUSINESSES ARE also taking the lead. One nonprofit group, Refrigerants, Naturally!, is pushing for a shift in cooling technologies that "do not harm the Earth's climate and ozone layer." The group's members include the Coca-Cola Company, McDonald's and Carlsberg, among others.

Other groups such as Beyond HFCs and Greenpeace have brought awareness of alternative refrigerants to consumers and lawmakers.

The obstacles for a quicker shift are simply money, equipment and an overall lack of legislation, says Shende.

"There are high, short-term costs of implementing new technology before it achieves an economy of scale," he says. "Also, natural refrigerants can be made by anyone; anyone can make hydrocarbons, ammonia or carbon dioxide. You can't patent them, unless you make something like a special hydrocarbon blend. So it is nowhere near as profitable for the chemical industry to invest in natural refrigerants as it is [to invest] in fluorocarbon refrigerants such as HFCs. Thus, the responsibility shifts to the equipment manufacturers to design equipment that is better suited to natural refrigerants."

Shende adds that it is important not to forget about refrigerants in the big picture of the causes of global warming.

"Don't just look at the leakage of HFCs from an appliance, but look at its energy use, which can account for 90 percent of its greenhouse gas emissions," he says. A refrigerator runs on electricity, and this is usually generated from a power plant burning fossil fuel.

"It is important to make sure that when you replace HCFCs with natural refrigerants you have energy-efficiency improvements too," he says. ■

NATURAL REFRIGERANTS TIMES THREE

As world economies grow, applications of refrigeration and air-conditioning systems increase. Natural refrigerants are gaining increasing interest as the refrigeration industry searches for alternative refrigerants that have low global-warming potential and zero effect on ozone in the stratosphere. The three most common natural refrigerants are ammonia, hydrocarbons and carbon dioxide (CO_2).

Ammonia has been widely used in industrial refrigeration and air-conditioning processes for more than a century, according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc. (ASHRAE). Its properties make it an ideal refrigerant, but it is also toxic in large quantities. It has a good safety record, however, due partly to its unpleasant and penetrating smell, which ensures that people will not stay near health-threatening concentrations.

Applications for ammonia-based refrigeration systems include: thermal storage systems, HVAC chillers, process cooling and air conditioning, district cooling systems, supermarkets, convenience stores, air conditioning for the International Space Station and Biosphere II, and increasing output efficiencies for power generation facilities.

Hydrocarbons such as propane and isobutane are effective refrigerants, but they are flammable. "The higher the refrigeration charge, the higher the fire risk," says Rajendra Shende, head of the OzonAction Branch of the United Nations Environment Programme. For many years, they have been used in industrial situations where all the equipment in an area had to be flameproof for other reasons.

Examples of commercially available equipment using hydrocarbon refrigerants include: domestic refrigerator/freezers and portable air conditioners, standalone commercial refrigeration systems, including beverage and ice-cream machines, centralized indirect systems for supermarket refrigeration and transport refrigeration systems for trucks.

Like ammonia, **carbon dioxide** has been used as a refrigerant for more than a century. It is neither flammable nor toxic, but it needs to be used under very high pressures, according to ASHRAE. Its low toxicity, nonflammability, zero ozone-depletion potential and low global-warming potential have attracted the attention of system designers since the early 1990s, when alternatives to chlorofluorocarbons were being sought, ASHRAE writes.

Since then, carbon dioxide has found widespread acceptance in the full range of vapour-compression systems, from low-temperature freezers to high-temperature heat pumps.

COOLING NATURALLY

A new district cooling plant uses seawater and natural refrigerants to supply cooling to nearby stores and offices in central Copenhagen. With district cooling the buildings can do away with huge air-conditioning systems, thus saving space, energy and CO_2 emissions.

TEXT: **JACK JACKSON** PHOTO: **ADAM HAGLUND**

Denmark's first district cooling plant supplies cooling to buildings in central Copenhagen.

In central Copenhagen, the red-brick smokestack on Gothersgade street used to send black smoke into the skies of this old, scenic part of the city, which is situated only a few blocks from the wooden ships, castles and sidewalk cafes of Kongens Nytorv. Since it shut down in the 1970s, Copenhagen's oldest power plant has stood vacant. Today the plant runs again. It is smoke-free and does not generate electricity but rather something else entirely, saving its customers 7 GWh of power and 3,000 tonnes of CO_2 emissions a year. Using the old, underground district heating network, the Gothersgade Works now provides district cooling.

The facility, owned by Copenhagen power utility Copenhagen Energy, supplies cooling to nearby banks, department stores and offices, keeping their computer server rooms and other areas cool and comfortable year-round. The plant runs with the help of natural refrigerants and local resources such as seawater and waste heat, keeping costs down and environmental benefits up.

District cooling works on the same basic principle as district heating, but with cold rather than hot water: A central plant produces chilled water and distributes it through an underground network of insulated pipes. Customers that connect to the pipeline network can use the amount of the chilled water required to fulfil their own cooling needs. Calculations show that customers changing over to district cooling can reduce their operational costs by up to 45 percent, including huge savings on electricity and expenses for service and repair.

INSTALLATION COSTS for district cooling are also much less than for individual cooling systems. All that is needed is a special heat exchanger unit and pump for customers to chill their own central cooling system water. They can then dispose of their conventional chilling units, opening up space and cutting electricity consumption for cooling, says Jan Don Høgh, department manager of Copenhagen Energy. "It depends upon how efficient a customer's cooling system is, but so far we have seen cost savings of 10 to 55 percent," Høgh says.

"Usually a building's [individual] central cooling system will need motors, pumps, filters, condensers and towers, and it might take up 300 square metres," Høgh says. "A district cooling installation has no moving parts, meaning it doesn't generate noise, and

SOLUTIONS WITH NATURAL REFRIGERANTS READILY AVAILABLE

Alfa Laval's solutions enable a shift away from harmful refrigerants to three common, environmentally friendly natural refrigerants: carbon dioxide, ammonia and hydrocarbons.

Carbon dioxide (CO2): Supermarket refrigeration systems are increasingly using CO_2 as a refrigerant, as well as for condensing or cooling gases at an ambient temperature. This solution works best in cooler climates, says Tommy Ångbäck, manager, Refrigeration & HVAC Cooling at Alfa Laval. Several Scandinavian and UK supermarket chains now use CO_2 as a standard solution. CO_2's physical properties require refrigeration systems to operate at more than five times the normal pressure of a classic refrigeration system. This puts new challenges on the components in the system.
Alfa Laval has developed a full range of heat exchangers to cope efficiently with these high-pressure systems. The range of heat exchangers for CO_2 applications includes cold room air coolers and ambient air gas coolers, along with brazed plate heat exchangers used as CO_2 economizers, evaporators or heat recovery gas coolers.

Ammonia: A modern ammonia refrigeration system offers good payback over the longer term, according to Ångbäck. Today's plate heat exchangers can reduce the volume of ammonia by 10 times or more on bigger indirect refrigeration systems compared with the old-fashioned shell-and-tube ammonia systems.

"We've supplied thousands of compact, efficient solutions with semi-welded plate heat exchangers with welded cassettes for large ammonia refrigeration plants," Ångbäck says. "These can now also handle higher pressures to deal with ammonia/CO_2 two-stage cascade systems for increased energy performance in low-temperature applications."

Smaller systems can apply the AlfaNova fusion-brazed plate heat exchangers made of 100 percent stainless steel. "You only need a very low charge of ammonia, and this makes the system cheaper and safer," says Ångbäck.

Hydrocarbons: Hydrocarbons are now widely used in household refrigeration appliances to replace harmful refrigerants. Bigger commercial systems can also run with propane as the refrigerant.

Alfa Laval's copper-brazed plate heat exchangers then come in handy to keep the flammable propane gas volume as low as possible in an indirect system, typically using a glycol solution or liquid CO_2 as a secondary coolant, says Ångbäck.

Jan Don Høgh of Copenhagen Energy (left) and Keld Almegaard of COWI show how the district cooling plant works.

it uses three to four square metres. That's important in this part of the city, where space is extremely valuable."

One of Copenhagen Energy's first customers, the Berlingske media house, added two extra employee parking spaces when it switched from its traditional air-conditioning system to district cooling, winning the space with the removal of gear in its garage. Even better, when the chilling components were dismantled from its roof, it could build a new cafeteria and conference rooms with a great view over the city.

DISTRICT COOLING ALSO reduces emissions. According to calculations by Copenhagen Energy, comparing district cooling with energy consumption and emissions figures for individual cooling plants in the buildings on Kongens Nytorv, there is a 66 percent savings to be made in CO_2 emissions per year. For sulphur dioxide (SO_2) and nitrogen oxide (NO_x), the annual savings is 62 percent and 69 percent, respectively.

The district cooling plant facility uses two 100-year-old cement pipelines that bring in seawater from 800 metres away – the essential factor in the plant's economic and environmental accounting. When the seawater is cold enough (from November to April), it does all the chilling work alone in a free cooling unit (see box on page 12). The rest of the year, the seawater is used as a cooling agent in the condensers of compressor chillers that use ammonia as a natural refrigerant.

"We're purely customer driven. This is a competitive concept where we can reduce CO_2 emissions without any subsidies."

JAN DON HØGH, COPENHAGEN ENERGY

In the summer, during times when cooling demand is highest, the plant also uses an absorption chiller that runs on waste steam from a local waste incineration plant, a process that's termed "absorption cooling". "If you consider this excess heat as pure waste, then the absorption chiller is almost 100 percent CO_2-neutral," says Høgh during a tour of the facility. He has to yell to be heard over the hum and buzz of the pumps and machinery, with its maze of thick silver tubes for the flowing cold water.

Copenhagen Energy's 12 MW plant started production in March 2010. While it was under construction in December 2009, several delegations from the UN-COP15 climate conference in Copenhagen came by for a tour to observe how it would be possible to reduce energy consumption for cooling in energy-demanding buildings. Just recently another of many Chinese groups visited. "They're very interested in district cooling," Høgh says. "They see it as a super alternative to what they have in their cities today."

THE DEMAND FOR cooling has been constantly increasing over the past 10 years, partly due to the growing use of IT and data storage. According to Copenhagen Energy, 40 to 50 percent of its customers' cooling demand is actually used in their server rooms.

The district cooling technology works

The district cooling plant includes seven Alfa Laval plate heat exchangers, chosen because of their "high efficiency and low pressure losses."

anywhere, but it is competitive only with certain key conditions, says Keld Almegaard of COWI, the engineering consultant who helped make the Copenhagen plant possible. "It has to be sized for at least 10 MW, and it's a good idea to have a harbour or source of water nearby – as well as access to waste heat," says Almegaard.

COPENHAGEN ENERGY had been ready for some time to start up the district cooling plant, but it wasn't until 2009 that the Danish legislative framework made it possible to operate district cooling systems.

"We saw a huge potential for this in Denmark," Høgh says. One more facility is in the pipeline for Copenhagen, with six other possible sites in planning. District cooling already had up to 15 years of success in a few European cities – with 450 MW of capacity in Stockholm and 550 MW in Paris – and, says Høgh, new projects are in the pipeline around the continent.

District cooling also provides a simple and economical way for building owners to phase out their chilling systems that run on hydrofluorocarbons or other synthetic fluorinated f-gases. These are the devastating greenhouse gases under scrutiny from the United Nations, environmental advocates and consumer groups (see story on page 6). Denmark requires a total phase-out by 2015.

"We're purely customer driven," says Høgh. "This is a competitive concept where we can reduce CO_2 emissions without any subsidies. It won't solve all the challenges Denmark has to reduce its greenhouse gas emissions, but it's one step to getting there." ■

SMART SYSTEM LEADS TO EFFICIENT COOLING

Copenhagen Energy's district cooling plant has a capacity of about 12 MW and is based on three different principles of cooling – free cooling, absorption cooling and compressor-based cooling. This makes it a very flexible and highly energy-efficient system. Alfa Laval has delivered seven plate heat exchangers to the plant: one titanium plate heat exchanger, three evaporators and three condensers.

Copenhagen Energy's Jan Don Høgh says the reasons for choosing Alfa Laval's heat exchangers are their "high efficiency and low pressure losses." Besides, he says, "Alfa Laval is a well-known supplier of heat exchangers."

The Alfa Laval titanium plate heat exchanger is used in the free cooling system where seawater is pumped up from the Port of Copenhagen and used to cool the district cooling water. Titanium plates must be used to avoid corrosion from the saltwater. In winter, when the seawater temperature is below 5.5°C and cooling demand is less than 2400 kW, Copenhagen Energy uses the free cooling system alone to cool the district cooling water.

When the seawater temperature is between 5.5°C and 11.5°C, the heat exchanger is used for precooling of the cooled water, before it's cooled by a compressor chiller system to the desired temperature. The Copenhagen plant has three such chiller systems. Each incorporates one Alfa Laval stainless steel evaporator and one Alfa Laval titanium condenser. The seawater is then used to cool the natural refrigerant ammonia in the condensers.

When the seawater temperature is above 11.5°C, the seawater is too warm to be used for free cooling, and the chillers provide all cooling.

The free cooling system is highly energy-efficient, explains Alireza Rasti, sales manager, Alfa Laval in Denmark. "When the seawater is cold enough to do the cooling job by itself, you don't have to run the compressors," he says. "By running only the seawater pumps, you consume only a fraction of the electricity usually needed."

PHOTO: MAURIZIO CAMAGNA

Francesco Biasion, CEO at Bifrangi, brings environmental concern to a new level.

GREEN VISIONARY EXTRAORDINAIRE

"There is always something more to be done"

CARP ARE SWIMMING in the pond, while pigs and cows graze near vineyards that sport a wide variety of vines. We're at the Bifrangi plant in Mussolente, a town in the northernmost part of the northern Italian province of Vicenza. But this plant does not produce food or drink; it presses, forges, turns and mills metal to produce flanges, fittings and components for wheel hubs. Not the sort of operation that springs to mind when you think of environmental awareness.

Yet environmental concern is at the top of Bifrangi's agenda. "There is always something we can do to help with environmental issues," says Francesco Biasion, Bifrangi's CEO, who with his brother Gino converted the old family-run forge back in the 1960s into the company we see today. "We test new products and solutions and invest in new equipment. We do everything we can to avoid contaminating the environment with pollutants."

This vision led Bifrangi to grow fruit and vegetables and breed animals on the company's land, so the company canteen can always rely on fresh local and seasonal produce.

But Bifrangi also makes sure that its industrial production conforms with the company's green agenda. In total, the Mussolente factory and the two Bifrangi plants in England use 18 centrifuge filtration separators from Alfa Laval. They clean oil and water from the cooling processes, allowing for continuous recycling. "By no longer stocking waste oils and emulsions we have shortened our production processes, and we buy 70 to 80 percent less new oil," Biasion says.

IN ADDITION, a chain of separators is used to treat Mobil Gear 630 oil as well as waste coolant emulsions. The separators have different functions, and together they purify the oil used by the presses, which is contaminated with metal scrap and water containing releasing agents. The line produces oil that is virtually identical to new oil; It contains less than five parts per million of water.

Last but not least, Bifrangi has an Alfa Laval Ecostream. This purifier was originally designed for cleaning bilge water and oil onboard ships and marine installations. Here it is used to clean stable emulsions when the mechanical centrifugal separating action is not enough to separate the oil from the water. This unique application for the system enables Bifrangi to clean all waste lubricants and coolants so it can reuse the water and also save on disposal. Two more Alfa Laval separators are also used at Bifrangi – one in the olive oil mill and the other in the winery.

Alfa Laval has provided equipment, technical advice and services to Bifrangi since 2006, and the two companies have developed a fruitful partnership. "We are reducing harmful emissions while also saving time and money," Biasion says.

MASSIMO CONDOLO

Unfinished wheel hubs at Bifrangi's Mussolente factory.

Cash from trash

Biofuels made from waste are taking off worldwide, and it's no wonder: They offer a way to reduce the use of fossil fuels and at the same time make a profit.

TEXT: **DAVID WILES** ILLUSTRATION: **ROBERT HILMERSSON**

"WHERE THERE'S MUCK, there's brass," so they say in northern England ("brass" being slang for money). Where there are dirty jobs to be done, there is money to be made, and that has never been truer than today, when industrial and domestic waste can be converted into sustainable, low-carbon fuels. What was once a cost for industry and society is now generating income.

It is perhaps the ultimate win-win situation: taking waste products that are an environmental and economic liability and transforming them into fuel for an increasingly energy-hungry but ecologically aware world. From biogas made from slaughterhouse waste and alcohol seized by customs officials in Sweden to biodiesel made from restaurants' used cooking oil in the United States to bioethanol made from agricultural waste in China the fuel-from-waste industry is emerging as a way to help cut reliance on fossil fuels.

"All biomass waste can be used for energy purposes," says Tomas Kåberger, director general of the Swedish Energy Agency and a former bioenergy industry executive and professor at the leading environmental institute at Lund University in Sweden. "The total global potential of residues from forestry and agriculture and other sources is between a quarter and a half of total commercial energy use, but sometimes the cost of utilization is too high. However, as oil prices

POWER TO THE PEOPLE – FROM SLURRY

Lemvig Biogas, built in 1992, is Denmark's largest biogas plant, producing about 8.5 million cubic metres of biogas a year to generate electricity and heat. The biogas is made from slurry from about 75 local farms, which are part owners of the plant, as well as waste and residual products from industrial production, including slaughterhouse and brewery waste, contaminated food and waste from the pharmaceuticals industry.

From the biogas produced, more than 21 million kWh electricity is generated per year and sold into the local power grid. The surplus heat from the gas engine cooling system exceeds 18.3 million kWh per year and is distributed to the users of the Lemvig central heating plant (about 1,000 households).

Biogas is produced by the biological breakdown of organic matter in the absence of oxygen. The Lemvig plant employs a method called "thermophilic fermentation," which uses bacteria that have to be kept at temperatures as close to 52.5°C as possible. Generating this heat would normally require about 9,000 MWh of energy, corresponding to 16 percent of the facility's total power output.

By using four Alfa Laval spiral heat exchangers, the Lemvig plant needs only 6,000 MWh of energy to maintain the temperature. The rest is retrieved by heat transfer using digested sludge as the hot media. The heat exchangers draw heat from the digested manure flows that cool from 52°C to 29°C to preheat the incoming undigested organic waste from 15°C to 44°C.

The solution brings improvements in revenue for the plant and its owners. "If we had to use the heat we produce to maintain the required operating temperature, we'd have much less to sell," explains Lemvig Managing Director Lars Kristensen. "Alfa Laval's heat exchangers have ensured us maximum efficiency."

have escalated the economic potential has increased significantly – and more quickly than people have realized."

Mankind generates an estimated 4 trillion tonnes of waste a year, so it makes an attractive energy source. And it has the obvious advantage of reducing fossil fuels use and subsequently greenhouse gas emissions. In the case of biogas and second-generation ethanol, there is a further benefit: When organic waste decomposes it creates methane, which is 20 times more forceful as a greenhouse gas than CO_2. If you use it to make second-generation ethanol instead, that methane is never released, and if you make biogas it is captured. "Reducing emissions of methane may be just as important as substituting fossil fuels in the engine," says Kåberger.

BUT FOR MOST BUSINESSES today, economic considerations still have the upper hand, and here biofuels from waste still make sense. "You avoid traditional waste management costs and produce a valuable product instead," says Kåberger. "There are opportunities that are very profitable today that were not profitable when these resources were evaluated five or 10 years ago, when the oil price was lower. And there are market opportunities that are still to be discovered."

Today the world leaders in biofuel development and use are Brazil, the United States, France, Sweden and Germany, although China is becoming a major player thanks to the likes of China Clean Energy, which is increasing its production of biodiesel made from recycled cooking oil and other waste food oils by 100,000 tonnes per year. The US military has taken a leading role in the fuel-from-waste industry, with projects ongoing to make jet fuel out of wood pulp and agricultural waste.

"The economic potential has increased significantly, and more quickly than people have realized."

TOMAS KÅBERGER, SWEDISH ENERGY AGENCY

The business potential of biofuels from waste can be seen in the fact that major corporations – including oil giants such as Shell, BP and Chevron – are also getting involved. British Airways is investing in a plant that will turn 500,000 tonnes of organic waste into 73 million litres of jet fuel per year, while Alfa Laval, which is a leading supplier of equipment to biofuel producers, has acquired Ageratec, a much-talked-about manufacturer of biodiesel processors.

"Some small startups are strong on the technology side but weak on marketing and

ULTIMATE GREEN FUEL IS LOCALLY PRODUCED

Finnish energy company St1 is making bioethanol for transport use. The fuel (basically alcohol) is made from waste and industrial side streams with the company's Etanolix method.

Etanolix has an extremely low carbon footprint: It uses waste as feedstock; it uses renewable energy in production; and it applies new energy-efficient processes and technologies. It also has minimal transport needs, as it is made in small production units that are built close to the source of the feedstock. In addition, by-products from the process such as fertilizers, animal feed and solid biofuel are utilized locally.

St1 currently has six waste-to-ethanol units producing 5,000 cubic metres of fuel per year from about 45,000 tonnes of waste.

The Etanolix process was designed specifically to convert food industry wastes and side streams into ethanol. It uses biowaste from food processing plants as well as food industry by-products that contain sugar, starch or low concentrations of ethanol. This includes potato processing waste, bakery waste and side streams, dairy industry waste and side streams, and brewery waste.

The production process involves the microbial fermentation of the sugars in the raw material. From the production units the 85 percent bioethanol is transferred to a separate dehydration unit for dewatering, after which the 99.8 percent bioethanol is ready to be blended with petrol and distributed to service stations.

St1 uses Alfa Laval compact plate heat exchangers in its ethanol rectification process. The heat exchangers are used for heat recovery, boiling and condensation. St1 also uses some raw materials, such as food industry waste, that require spiral heat exchangers that can heat sludge or fibrous media better than other technologies.

St1 is developing new methods to utilize an even wider selection of wastes and industrial side streams. Its next-generation plants, which are currently under development, will run on commercial packaging and straw, among other materials.

scaling up production, and they benefit from joining large established companies," says Kåberger.

Gert Ternström, marketing manager biofuels at Alfa Laval, says that technology development has helped create a situation in which biofuels made from waste can compete with fossils fuels on increasingly even terms. "If you look at making diesel from animal fat, it is a more difficult process than making it from crude vegetable oil, but the cost of production has been reduced significantly," he says. "We are now in a more mature phase of the biofuels business where an infrastructure has been built up. So making fuel from waste is a no-brainer when you look at it today, although it was just a few years ago when you didn't have the incentives to run this business."

KÅBERGER EXPECTS the fuel-from-waste market to grow rapidly in the short term. "As they [fuel-from-waste businesses] are growing from a very small scale they will not get major market share in the short term because the fossil fuel market is enormous," he says. "But in the longer term they will become a significant part of the automotive fuel market because oil resources are limited and biofuels are not."

The main technical breakthroughs needed for wider implementation of biofuels from waste have already been made. "There are a lot of opportunities for marginal improvements in yields and marginal reductions in cost, but I don't think we can identify one key solution that will make it more competitive," says Kåberger.

The political constraints to wider implementation of biofuels made from waste are minor. For instance, the European Union's biofuels directive commits member states to 10 percent biofuels in traffic fuel by 2020.

"I think the most important constraint is that too few people understand the technological and economic opportunities," says Kåberger. "Waste has always been waste, and few have the imagination to realize that it can be industrially converted into automotive fuels at reasonably low cost. By doing so, you reduce the economic and environmental costs of handling it and at the same time create a new revenue stream." ■

FUEL FROM FAT BOOSTS ENGINE PERFORMANCE

In the northern German town of Malchin, Saria Group subsidiary ecoMotion has been producing second-generation biodiesel from animal by-products since 2001. The raw material for the plant includes animal fat from a nearby rendering factory as well as used cooking oil.

The Malchin plant is one of three owned and operated by the Saria Group, with a total capacity of 212,000 tonnes of biodiesel per year. Their output has the potential to save nearly 400,000 tonnes of CO_2 per year – equivalent to the emissions of 170,000 households or about the same number of cars.

During the process, the raw material and a methanol catalyst mixture are pumped to a unit where they undergo a process called transesterification. The biodiesel is created by an alkali catalyzed reaction between fats or fatty acids and methanol.

The facility, which produces 12,000 tonnes of high-quality biodiesel per year, uses the Alfa Laval Centrifine process to purify fats from slaughterhouse by-products until they contain no more than 0.15 percent impurities by weight. After cleaning with a decanter centrifuge and disc stack centrifuge, the product can be used to produce steam or biodiesel.

The fuel itself is 97 percent pure, with a low sulphur content. By-products of the process include solid fertilizer and glycerine, which in turn can be split into free fatty acids, crude glycerine and solids. Free fatty acids are reused and converted into more biodiesel, while crude glycerine and solids are sold for further processing.

Besides the environmental benefits, recent studies have shown that biodiesel produced from 100 percent animal fat – also called animal fat methyl ester, or AFME – contributes to better overall engine performance. Compared with conventional fossil diesel, this type of biodiesel improves engine efficiency, reduces exhaust emissions and lowers engine noise levels. For second-generation biodiesel made from animal fats, particulate matter and CO_2 concentrations are even lower than for rapeseed oil methyl ester (RME, or first-generation biodiesel made from rapeseed oil). AFME also has better lubricating properties than RME.

Fuel from the Malchin plant has been used in more than 1,000 trucks since production started in 2001. Tests have proved the benefits with regard to emissions with no increase in technical faults.

ALFA LAVAL PRESENTS A COMPLETE PORTFOLIO FOR CLOSED-LOOP COOLING

new launch **Alfa Laval T45-M**

Heat exchangers rising to the cooling challenge

A WELL-WORKING, cost-effective central cooling system is key in many process industries, including petrochemical plants, refineries, power plants and other heavy-duty industrial environments. More and more companies are realizing the benefits of installing a closed-loop cooling system in connection to or instead of stand-alone cooling towers. In response to the growing need, Alfa Laval has brought T45-M to the table – a brand new plate heat exchanger that completes the company's portfolio for closed-loop cooling solutions.

"The Alfa Laval T45-M is optimized for closed-loop cooling in terms of thermal performance, pressure performance and scope of supply," says Fredrik Bertilsson, Group launch manager at Alfa Laval. "We have put all of our knowledge from research and development and our numerous years of experience into making a plate heat exchanger that meets our customers' current demands. With the T45-M in our portfolio, we can ensure modern, tailor-made solutions that meet any system requirements our customers may have."

A closed-loop cooling system uses water from an external source, such as the sea, a lake or a river, to cool water used in the plant process. The external cooling water and the process water are then held separate from each other, running in two different circuits. Since the external cooling water and the process cooling water never coincide, the risk of process water contaminating the external water source is eliminated. Meanwhile the risk of fouling and the need for cleaning and maintenance are reduced because no external water enters the process, which means the use of chemicals and chlorine is kept to a minimum.

"The initial investments are still higher for closed-loop cooling systems than for cooling towers, but thanks to the lower operational costs, the closed-loop cooling system is more cost-efficient in the long term," says Wivika Laike, segment launch manager at Alfa Laval. "Adding the environmental benefits, we believe that closed-loop cooling is always the best option where possible."

ALFA LAVAL'S PLATE heat exchangers for closed-loop cooling comprise units with portholes of from 300 to 500 millimetres and flow capacities of up to 4,700 cubic metres per hour. In terms of size, thermal performance and pressure performance, they are all suitable for closed-loop cooling systems (i.e., they are all big enough to deal with high flow rates, are thermally suited for the temperature programs used in this type of cooling system and are robust enough to handle the necessary pressures).

Alfa Laval also offers its ALF filters, designed for installation with plate heat exchangers in closed-loop cooling. The filters remove unwanted objects from the external water before the water enters the heat exchangers. Which types of heat exchangers and filters to use, their size, capabilities and design, depend upon the duty at hand.

Bertilsson says closed-loop cooling projects are often complex, as most systems include a battery of plate heat exchangers and filters. In addition, the requirements from customers are typically very specific. "We have the necessary skills and experience to select, dimension, manufacture, document and deliver the best possible solution," he says. "We also support our customers before and after the actual installation with everything from design optimization to start-up testing and servicing." ■

Customer's voice

"We will use Alfa Laval T45-M units in a central cooling system at a utility plant of an affiliate to a major producer of chemicals and plastics in Saudi Arabia. The plate heat exchangers will help to increase both production efficiency and the quality of the products produced.

"Alfa Laval has brought lots of experience and confidence to the project. All the people involved have shown great ability in their work and have taken quick action to solve any problems along the way."

Yoon Jong In
Assistant manager, Mechanical Engineering Team, Samsung Engineering Co. Ltd.

The Alfa Laval T45-M.

BENEFITS

- Closed-loop cooling with plate heat exchangers requires less maintenance and less pumping compared with stand-alone cooling towers, resulting in significantly lower operational costs.
- Alfa Laval has a complete range of plate heat exchangers, filters and service offerings tailored for customers using close-loop cooling.
- Alfa Laval's plate heat exchangers are easy to optimize for each duty at hand. Porthole sizes, number of plates, plate thickness, material and corrugation patterns can all be varied to meet thermal duty, pressure-drop and other design specifications.
- Should the cooling demands change over time, Alfa Laval's plate heat exchangers can easily be adapted to new operating conditions due to the modular design.
- The new Alfa Laval T45-M is optimized for closed-loop cooling in terms of thermal performance, pressure performance and scope of supply.

PRESERVING THE BIG BLUE

The *JRS Brisbane* looks just like any other container ship as she approaches Sidney's Port Botany this drizzly winter morning. But onboard the vessel hides cutting-edge technology for cleaning of ballast water, helping to keep a natural disaster at bay.

TEXT: **STEPHANIE OLEY** PHOTO: **PAUL WRIGHT**

The winter storms outside Australia's east coast have eased, but it's been a restless two-and-a-half days for the *JRS Brisbane's* Captain Konstantin Bukhantsev and his crew since leaving Brisbane, about 1,000 kilometres north of Sydney.

Although the container ship sails on an ultra-modern navigation system hooked up to a global network via satellite, it must work hard to steady its half-full cargo. A half-full ship must take on ballast water to ensure stability and lower its draft, ensuring that the propeller is properly immersed.

"A ship might be made of steel, but it can snap in two and sink in an hour if the freight isn't evenly distributed," explains Bukhantsev, as he sketches a freighter with its middle bent from having too much cargo fore and aft and not enough in the centre.

"Water ballast treatment will help us and the next generation keep our oceans fresh and clear. My crew and I want to see the Earth in green and blue, not grey."

KONSTANTIN BUKHANTSEV, CAPTAIN, *JRS BRISBANE*

When ships take on ballast water, they also unintentionally take on a host of microscopic marine organisms. These can wreak devastating environmental effects when discharged abroad.

Currently most ships follow an International Maritime Organization (IMO) recommendation to exchange ballast water mid-ocean, where few microorganisms survive – preferably 200 nautical miles offshore and in waters 200 metres deep. This minimizes the inadvertent transfer of tiny live organisms from one coastal ecosystem to another.

But the *JRS Brisbane* is different. Built in 2009, it's fitted with PureBallast, an innovative technology that has cut this time-consuming task from the crew's to-do list.

DEVELOPED BY ALFA LAVAL in cooperation with Wallenius Water, PureBallast is a fully automated and highly effective system for cleansing ballast on board. It purifies the water via a combination of filtration and advanced oxidation technology (AOT). Both methods are safe for the crew and environment.

The system is so effective it can eliminate organisms as small as 10 micrometres and in greater quantities than what the IMO legislation calls for.

Bukhantsev, who hails from the Russian resort town of Sochi on the Black Sea, has known first-hand the billion-dollar damage that ballast exchange can wreak. Black Sea fisheries were devastated in the 1990s as a result of a ballast-introduced aquatic invasion (see sidebar on page 23).

"We have to care about the marine environment because this is our planet and our home," he says. "Water ballast treatment will help us and the next generation keep our

Electrical engineers Phone Naing and Ramon Lopez are very pleased with Alfa Laval PureBallast, especially with what it will do for the environment.

WMS SHIPMANAGEMENT

WMS Shipmanagement: Germany is experiencing something of a shipping boom. WMS Shipmanagement GmbH & Co KG is a young company with a brand-new fleet and big plans to capitalize on a growth area.
Founded: 2006
Headquarters: Hamburg, Germany
Number of ships: 13
Number of employees: 15
Types of ships: 12 container ships (700 to 900 TEU); one multipurpose cargo ship (9,300-tonne dead weight)
Average age of ships: 2.5 years (oldest ship is 5.5 years)
Routes: Worldwide

Chief engineer Aleksandr Bezrukov says PureBallast is very easy to operate.

oceans fresh and clear. My crew and I want to see the Earth in green and blue, not grey."

Scientists first recognized the damaging problem of ballast transfer in 1903, after a toxic bloom of odontella (*Bidulphia sinensis*), an Asian phytoplankton, in the North Sea.

Inter-oceanic shipping flourished in the 20th century, and in the 1970s scientists began examining the issue more closely.

Several ballast water recommendations have been introduced since, with the most far-reaching of these being the IMO's ballast water management that came out of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments (see sidebar on page 22). The convention's guidelines will soon be mandatory worldwide, and already countries such as Canada and Australia have made them compulsory. Rigorous documentation of ballast intake and output is one important stipulation, and the ruling on offshore ballast exchange is another. But this step is not easy.

"Reballasting means the ship has to stop offshore and spend four, maybe five, hours to exchange ballast," says Bukhantsev. "That's a difficult thing to do in a storm. Treating ballast on board makes things a lot easier."

Once it takes effect, the convention will call for all ships to use ballast water treatment systems by 2016.

In response, some 24 ballast-treatment systems have already been developed around the world and received basic approval from the IMO. Their developers include shipping and technology heavyweights in Germany, Japan, Korea and Sweden. Twelve have received IMO final approval.

BUT ONLY NINE SYSTEMS had received IMO-type approval and full certification from their national administration as of July 2010. Alfa Laval PureBallast is one of them. The owners of the *JRS Brisbane*, WMS Shipmanagement in Germany, considered several alternatives before making their final decision.

"Of the options available to us at the time, only PureBallast did not use chemicals to kill the organisms, so we felt it was the most environmentally friendly," says Georgios Chalaris, the company's superintendent engineer. "It had just received final approval by [Norwegian risk management giant] DNV."

Apart from its environmental benefits, there are several commercial advantages, Chalaris continues.

"It saves us the time, labour and cleaning agents normally used to treat the inside of ballast tanks," he explains. On a ship the size of the *JRS Brisbane,* this process takes place twice every five years and costs around 20,000 euros each time. "There are also reduced port fees and other commercial

Why PureBallast is different

With its zero-chemical technology and compact design, Alfa Laval's PureBallast is an ingenious solution to a far-reaching problem.

Alfa Laval's PureBallast system treats ballast water without using chemicals.

Alfa Laval PureBallast, developed in cooperation with Wallenius Water, is a sophisticated ballast water management system comprising filtration and UV treatment. It is so powerful it can eliminate microorganisms as small as 10 micro-metres.

The compact, fully computerized system runs automatically.

During ballasting, PureBallast's main pump first draws in water via a 50-micron filter, which prevents the intake of larger organisms and reduces the build-up of sediment in ballast tanks.

The water then moves through one or more advanced oxidation treatment (AOT) units, where intense UV light breaks down any organisms remaining.

Water is treated again by AOT during deballasting to neutralize any growth that may have occurred during the journey. Depending on how many AOT units are installed, PureBallast can process between 250 to 2,500 cubic metres of ballast water per hour (m3/h).

The system can be installed on new vessels or retrofitted on existing ones. A new version, PureBallast 2.0, was released in September 2010 and will further simplify installation, thanks to fewer electrical cabinets. Operation is also made easier on PureBallast 2.0, and it will reduce power consumption by 40 percent.

Apart from its speed and efficiency, a huge accomplishment of PureBallast is its 100 percent chemical-free technology. "There is no risk to the crew, no risk to the vessel and no risk to the environment," says Per Warg, business manager for PureBallast.

"The inspiration for AOT comes from completely natural processes," he continues. "Free radicals are formed in nature when sunlight strikes water, and these reactive radicals create an environment in which organic and inorganic substances oxidize. Many of today's smart products, such as self-cleaning skyscraper windows, draw on this technology."

To date, four methods have been certified as meeting criteria set out in the IMO's 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments (see sidebar): mechanical treatment (such as filtration), physical treatment (such as purification via UV rays), chemical treatment (such as biocide) or a combination of the above.

"At first glance, other type-approved systems have the same performance since they meet the IMO standard," says Warg. "However, we see clear advantages with Alfa Laval PureBallast. For example, the free radicals remain effective even when the water has a high sediment content. Also, the radicals actually break down cellular membranes, destroying the microorganisms rather than rendering them unable to reproduce. No microorganisms should slip through the system alive." ■

THE IMO CONVENTION – A SNAPSHOT

Regulations arising from IMO's 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments will take effect 12 months after ratification by 30 states, representing 35 percent of world gross merchant tonnage.

Twenty-six countries have already ratified (24 percent of world tonnage), making full enforcement likely within the next two years. Once the regulations are put into practice, some of the new requirements will be:

- Purify or exchange before discharging
  – By 2016, all ships must use ballast water management systems and will be inspected periodically to ensure that they comply with standards.
- Meet strict new standards
  – The goal is to achieve a purification rate of only 10 microorganisms exceeding 50 micrometres in diameter per cubic metre of treated ballast.
- Document treatment of ballast
  – Ships must maintain a Ballast Water Record Book to record the intake, circulation, treatment and discharge of ballast water.
- Provide reception facilities
  – Ports and terminals must provide facilities for sediment discharged during the ballast-cleansing process.

Thanks to PureBallast, the crew onboard the *JRS Brisbane* doesn´t have to exchange ballast water mid-ocean.

> **“PureBallast did not use chemicals to kill the organisms, so we felt it was the most environmentally friendly option.”**
>
> GEORGIOS CHALARIS, WMS SHIPMANAGEMENT

incentives for treating ballast on board.”

Chief engineer Aleksandr Bezrukov leads the way to an engine room humming with machinery while the ship is being loaded. It’s noisy but nowhere near as deafening as when the ship is in full steam and the engine crew must wear protective earmuffs.

We inspect the compact PureBallast system, which is slightly smaller than an adjacent pump that delivers cool water to the engines.

“This is very easy to operate,” the lean Russian explains. An LCD screen displays a technical diagram of PureBallast. “It runs automatically, so we just check that everything is working smoothly.”

ACCORDING TO Alfa Laval, PureBallast will last the lifetime of a ship – 25 to 30 years. The only major maintenance tasks ahead for Bezrukov and his colleagues are inspecting the filter and changing the UV lamps. But that won’t be for awhile. “If there were any problems, the computer would identify them straightaway,” he says. “But I don’t think we’ll have problems for a long, long time.”

Working alongside Bezrukov is electrical engineer Phone Naing from Myanmar and Ramon Lopez from the Philippines. The three each have an average of 20 years’ experience in their professions aboard ships, and all have seen their marine environment change greatly in this time.

The example of comb jellyfish in the Black Sea is famous. And the dinoflagellate algae causing toxic red tides are endemic in Lopez’s native Philippines. “The best thing about PureBallast is what it will do for the environment,” says Naing.

In addition to providing positive environmental benefits, Alfa Laval PureBallast also provides a glimpse into the high-tech future of shipping. “In the 1980s and ’90s, we controlled most things in the ship’s engine room manually,” says Lopez. “From 1995 or 2000 onwards, the electronics became more complex. Maybe in another 20 years’ time, there will be robots on board.” ■

CRITTERS ON THE LOOSE

Until zero-ballast ships are developed, the practice of using ballast water to stabilize partially loaded or unloaded ships will remain essential to safe shipping. Yet the effect of ballast water transfers is so damaging it is now considered one of the four greatest threats to the world’s oceans, along with land-based sources of marine pollution, over-exploitation of living marine resources and physical alteration/destruction of marine habitat.

Below are some of the major maritime disasters caused to date by alien organisms carried to new ecosystems in ballast water.

North American Comb Jellyfish (*Mnemiopsis leidyi)*
Origin: East coast of North and South America.
Relocation: Black, Azov and Caspian Seas.
Impact: Since its introduction to the Black Sea in the late 1980s, the fast-reproducing comb jellyfish has altered the ecology to the point where it has decimated fisheries – especially anchovy, horse mackerel and sturgeon. Recently, a natural predator, the *Beroe ovata* jellyfish, has been accidentally introduced to the region, helping to cull the comb jellyfish but with an unknown future impact.

Toxic Algae
(red, brown and green tides)
Origin and relocation: Various.
Impact: Forms harmful marine blooms that can suffocate a marine area of oxygen, fouling beaches and affecting tourism. Some species may contaminate filter-feeding shellfish, leading to illness or even death if the shellfish are consumed.

Zebra Mussels
(Dreissena polymorpha)
Origin: Eastern Europe (Black Sea).
Relocation: Northern and western Europe and North America.
Impact: First spotted in North America in 1988, these striped molluscs have multiplied across the eastern half of North America, choking waterways, pipes and other infrastructure. There is no known technology to eliminate the mussels. Eating them is not recommended, due to the polluted environs they inhabit and the poor quality of their meat.

Zebra mussels.

High-tech healing

Drugs produced by biotechnology are spreading quickly across the globe, raising hope for safer, more effective cancer treatments. Crucial for large-scale production of these complex drugs is gentle but effective separation technology.

TEXT: **MARTIN NEANDER** PHOTO: **ROCHE**

WHEN ALEXANDER FLEMING discovered penicillin in 1928 it was a major medical breakthrough. His observation that colonies of the bacterium *Staphylococcus aureus* could be destroyed by the mould *Penicillium notatum* led to the development of medicines that could kill certain types of disease-causing bacteria inside the body, effectively treating many previously serious diseases such as syphilis and Staphylococcus infections.

Although many types of bacteria have since become resistant, penicillin is still widely used today, and pharmaceutical drugs continue to play a major role in health care worldwide.

However, life expectancy is rising around the globe, and people are running greater risks today than they did even 20 years ago of being affected by various other serious ailments. The need for treatment for different types of cancer, for example, calls for highly advanced drugs and new production methods.

The latest production technique for complex protein-based drugs is cell culture-based drug production. From the initial research carried out in the United States in the 1980s it has spread across the globe to Europe and lately to Asia. In fact, growing and harvesting mammalian cells to produce new medicines has turned into one of the most thrilling sections of the life science industry.

Proof that microbial and pharmaceutical drug production is in a negative trend and that cell culture-based drug production is on the rise comes from the US Food and Drug Administration statistics. Of 100 new drugs per year that are filed as new drug applications (NDAs), about 60 rely on cell culture-based production, while only 15 are produced by microbial fermentation (the remaining 25 are produced by traditional chemical processes). Out of the 100 NDAs, about half address cancer diseases.

FROM A DRUG PRODUCTION perspective, there are huge benefits to be found in the cell culture process. Compared with production using microorganisms, the mammalian cell can produce complex proteins that target diseases better and in a more direct and structured way, which is of great importance for cancer drugs based on monoclonal antibodies. These bind only to cancer cell-specific antigens and induce an immunological response against the target cancer cell.

The cell culture-based production process basically involves three steps: fermentation, harvesting and purification. Fermentation involves the growth of the mammalian cell broth. In the cell-harvesting phase, cells are separated from the fermentation broth. The liquid or "centrate" from the harvesting stage is then purified, and the desired protein is separated and collected.

Research in the mammalian cells field to create advanced medicines began in the 1980s. From the start, Alfa Laval worked with industry leaders in the development of large-scale cell culture fermentation. During this journey, it became obvious that cell culture characteristics called for an extremely gentle separator design.

Centrifuges have a powerful ability to separate in a continuous mode and can reach very high G-forces in rotation, which benefits the cell-harvesting process. However, because mammalian cells are fragile and easily break apart, the design of the harvesting centrifuge is crucial. If shearing forces are generated at the inlet, cells are torn apart. Separation becomes highly difficult, and the flow rate has to be kept lower.

"Thanks to the gentle design of our Culturefuge separators, the fragile cells are not torn apart, and full separation is achieved

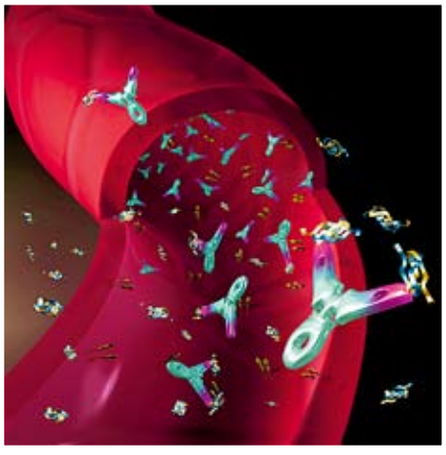
AVASTIN AGAINST CANCER

AVASTIN, DEVELOPED BY US biotech company Genentech, is one of the newest cancer-treatment drugs produced using cell culture technology. It is a protein that slows down the development of cancer by restraining the formation of blood vessels in tumours. Avastin is made from mammalian cells.

To provide additional production capacity for the production of Avastin, Roche Pharma Biotech Production Basel has built the MAB Building 95 in Basel, Switzerland. It has 6 x 12.5 cubic metres of fermentation capacity and two downstream processing lines for the recovery and processing steps that yield the final product. Alfa Laval has delivered equipment to the building for the production of this innovative cancer drug.

Cell-culture processes have opened up large-scale production of new cancer-treatment drugs.

Below: Antibodies in a cancer-treatment drug enter the bloodstream, where they bind to VEGF (vascular endothelial growth factor) secreted by the tumour.



even at high flow rates," says Tom Manelius, manager, Process Analysis & Design at Alfa Laval.

The single most important location inside the centrifuge is the acceleration zone, where the fermentation broth is accelerated within fractions of a second. "Our way of designing the acceleration zone has been crucial to the superior performance in the harvesting of mammalian cells," Manelius says.

THE LEVEL OF lactate dehydrogenase (LDH) is one way to measure the shear in cell culture processes. LDH is an enzyme released from damaged cells; the greater the concentration, the larger the percentage of broken cells.

"Growing and harvesting mammalian cells to produce new medicines has turned into one of the most thrilling sections of the life science industry."

Manelius says that the inlet design used in traditional microbial fermentation may generate an LDH increase in the range of 10–20 percent. "When using the extremely gentle liquid-filled inlet in our Culturefuges, the LDH elevation typically stays under 5 percent," he says.

The hollow spindle design of Alfa Laval's Culturefuge product range allows the gentlest acceleration possible in a centrifugal disc stack separator, according to Manelius. This reduces the destructive shearing forces that the cells are exposed to.

"The use of a hollow spindle also eliminates an air-liquid interface, because the feed zone is completely filled with rotating liquid," he says. "This is unique compared with other solutions on the market. The hermetic outlet ensures that there is no contact with the air or any external environment. In this way, foaming is avoided."

Another source of undesirable shear forces is the feed pump. With the Alfa Laval Culturefuge design this is not an issue because it does not use a feed pump. Instead, the fermentation broth is fed to the harvesting centrifuge by applying overpressure to the fermentor.

Manelius says an interesting result was found in a research study when comparing two disc stack centrifuges – one with a classic nonfilled acceleration zone and the other with a hollow spindle hermetic inlet for gently accelerating the feed. The research group found a 2.5-fold increase in throughput for the same clarification performance when processing through a hollow spindle-type centrifuge. ■

Teamwork that matters

The International Maritime Organization has vowed to make significant cuts in emissions from ocean-going vessels. Alfa Laval has teamed up with two market leaders to offer pioneering solutions to address this global issue.

TEXT: **JAMES PEARSE, DAVID WILES** ILLUSTRATION: **ALEXANDER RAUSCHER**

GLOBALIZATION HAS intensified trade between the East and West, and today some 90 percent of the resulting cargo is transported by sea. While sea freight is cost-efficient and compares favourably with other means of transport in terms of overall gas emissions, some specific air pollutants are a cause of concern. Thus the industry is investing heavily to improve its environmental performance.

Two key groups of pollutants that are being targeted by the shipping industry are sulphur oxides (SO_x) and nitrogen oxides (NO_x), which harm both human health and the environment. The International Maritime Organization (IMO) has vowed to cut emissions of these compounds – in the case of NO_x by 80 percent – in certain geographic areas, known as emission control areas (ECAs).

With its high-speed separator technology, Alfa Laval is collaborating with other leading engineering companies to find the solutions needed to make such reductions possible. Staffan Konigsson, process analysis and design expert at Alfa Laval, says he is confident these measures will help change the way the shipping industry works. "[Using high-speed separators] we are breaking new ground, as other solutions simply don't work with such small particles," he says. "It is a very challenging project to minimize waste volume on this scale."

NO_x ARE FORMED during the combustion process as a result of the combination of nitrogen and oxygen from the air at high temperatures. They cause acid rain, which in turn causes acidification and over-fertilization of the sea and land.

In a project to reduce these emissions from ships' engines, Alfa Laval was selected to collaborate with the Danish arm of German giant MAN. The engine builder is currently developing and testing technology in the exhaust gas recirculation (EGR) system for large two-stroke diesel engines that can reduce NO_x emissions by 80 percent.

> **"We expect to fully meet the IMO criteria for the discharge of scrubber wash water."**
>
> JOHAN KALTOFT, MAN DIESEL

As part of this system, a scrubber removes sulphur and particles from the exhaust gas using jets of water. Alfa Laval's separator solution aims to then purify this water so that it does not interfere with the EGR process, and at the same time it achieves the IMO directive on the purity of water discharged into the sea.

"MAN has found Alfa Laval separators very promising," says Johan Kaltoft, MAN diesel and turbo project manager. "[Once the NO_x-reducing technology is completed] we expect to fully meet the IMO criteria for the discharge of scrubber wash water, while keeping the EGR scrubber system in a clean and stable running condition."

Lena Sundquist, Alfa Laval's market unit manager for Marine & Diesel, explains: "Because of the results from the land-based research, we were invited to be part of the ongoing tests on board the container ship from AP Moller-Maersk, which will take place over one to two years."

SO_x FORMS DURING the combustion process when sulphur in the fuel combines with oxygen. Besides contributing to acid rain, SO_x in high concentrations can impair lung function in humans. Alfa Laval has teamed up with scrubber producer Aalborg Industries, a specialist in SOx-capturing technology, to reduce these emissions. Aalborg's scrubber, the largest marine unit installed today, was installed on a North Sea RO-RO Vessel in 2009, and in May 2010 it was tested on seawater for the first time. Alfa Laval high-speed separators clean the dirty water coming from the scrubber.

Lars Munch Antonsen, general manager, Group Global Marketing & Customer Relations Management at Aalborg Industries A/S, says he is pleased with the progress Alfa Laval is making. "Alfa Laval is a well-known player in the maritime industry," he says. "It was chosen because of its proven skills in designing equipment for the merchant fleet and its expertise in the separation of fluids and particles."

At Alfa Laval, Sundquist says that the separator solution has proved so successful that she is confident that the results of the project will fully comply with IMO targets on discharge water from the treatment of both NO_x and SO_x emissions. ■

REGULATIONS CONCERNING SULPHUR OXIDES AND NITROGEN OXIDES

1. Regulations include caps on the sulphur content of fuel oil as a measure to control sulphur oxides (SO_x) emissions. Special fuel-quality provisions exist for SO_x in emission control areas (ECAs).

Fuel sulphur limits (FSL) in ECAs are currently set at 1.0 percent. At the global level they are currently being reduced from 4.5 percent to 3.5 percent. By 2015, FSL in ECAs will stand at 0.1 percent (with global limits set for further reduction, from 3.5 percent to 0.5 percent by 2020).

2. The MARPOL Annex VI legislation, which went into effect in May 2005 following specifications from several European Union directives, has curbed the impact of marine diesel on the environment.

By 2015, countries that form part of an ECA will start imposing a FSL of 0.10 percent (1,000 ppm), and by 2016 newly installed marine diesel engines must comply with a NO_x cap of 3.4 g/kWh when operating within an ECA and 14.4g/kWh when operating outside an ECA.

TWOFOLD TRIUMPH

Why let heat go to waste when there are efficient methods to make good use of it? And why not make heat and electricity from old garbage? The Czech company TEDOM addresses both questions, bringing its cogeneration units into play.

TEXT: **JANA HOLÁ** PHOTO: **VLADIMIR WEISS**

WHEN RESIDENTS of a housing estate in the Letňany district of Prague, the Czech capital, throw out their garbage, they get it back in form of heat and electricity. That's thanks to TEDOM's cogeneration units that use landfill gas from two major waste dumps in Prague to generate heat and power.

TEDOM produces cogeneration units powered by natural gas or renewable energy sources such as biogas or gas from water treatment plants, landfills and coal mines. The idea behind cogeneration is to make use of the heat generated from energy production, an environmentally sound process that leads to immense fuel savings and reduced CO_2 emissions. Compared with traditional energy production, TEDOM annually cuts CO_2 emissions in the Czech Republic alone by nearly 250,000 tonnes.

"The basic strategy and philosophy of TEDOM are energy savings and a responsible and considerate approach to the environment," says Josef Jeleček, one of the owners and general director of TEDOM.

JELEČEK IS A FIRM believer in combined heat and power generation. He founded TEDOM 20 years ago and has seen it become a leading producer of equipment for combined electricity and heat production in Europe.

He says cogeneration can be successfully applied in any climate, although the advantages are larger where heating rather than cooling is the prime application. TEDOM exports its technology to more than 35 countries, including Russia, China, Australia and countries of Europe and the Americas.

Josef Jeleček, who founded TEDOM about 20 years ago, has seen the company grow and prosper.

One of the company's largest markets is Russia, where the development of the electricity distribution network lags behind the fast pace of housing construction. Cogeneration units are used as energy sources for newly built residential districts as well as industrial plants and health-care and sport facilities that can't be connected to the central power grid.

In Western Europe, cogeneration units complement the existing systems. In addition, the number of micro-cogeneration units installed in private residences has been increasing as owners' awareness of environmentally friendly solutions increases.

In the Czech Republic, cogeneration still needs special support to be on an equal footing with the conventional power producers, which use sources that are less costly but more harmful to the environment. "We sell energy on the site of consumption or close to it, while central sources have to transport energy via a distribution network to the customer," Jeleček says. "Yet we have the same price."

TEDOM RECEIVES A GREEN bonus that varies depending on the size of the energy source, which has to meet the EU efficiency standard. Although natural gas still makes up some 60 percent of fuel in the TEDOM-produced cogeneration units, the share of renewable energy sources has been rising.

Ten years ago, TEDOM started to use landfill gas in cogeneration. The gas from the decomposition of biological waste contains a high amount of methane and CO_2 that would considerably burden the environment with greenhouse gases if leaked from a waste dump spontaneously. The efficient liquidation of these gases in cogeneration units is therefore a great environmental benefit.

TEDOM's most extensive project of landfill gas processing is located in Letňany. There, TEDOM runs five cogeneration units in continuous operation that utilize landfill gas from Prague's two major waste dumps, Ďáblice and Chabry. The total electricity output is almost 5 megawatts and the heat output more than 7 megawatts. The heat from cogeneration is delivered not just to the housing estate in Letňany but also to a nearby truck production plant and a secondary school complex.

LONG-TERM COOPERATION

Alfa Laval has been TEDOM's main supplier of components for cogeneration units, in particular dry coolers and heat exchangers, for six years. It is now the company's exclusive supplier of dry coolers.

"There were no other dry coolers available on the market that could meet Alfa Laval's excellent qualities in terms of noise and efficiency," TEDOM General Director Josef Jeleček says. "Alfa Laval is one of our reliable suppliers, and we are very satisfied with our relationship."

Gas pipelines run across the waste dumps Ďáblice and Chabry, providing TEDOM's cogeneration units with landfill gas. The generated heat is delivered to a nearby housing estate, truck production plant and school complex.

THIS IS COGENERATION

TEDOM's cogeneration unit CENTO T 160.

Cogeneration is one of the most efficient methods of energy generation based on the utilization of heat from power production. In combined heat and electricity generation, fuel utilization can reach 90 percent with minimal loss.

A cogeneration device, known as a combined heat and power (CHP) unit, is a generator with a gas combustion engine that mainly uses natural gas but that can also run on alternative and renewable fuels such as biogas or gas from landfills, mines and water treatment plants. Most recently, "trigeneration" units have been used for the combined production of power, heating and cooling, where cooling is produced from heat by means of absorptive coolers.

Unlike power plants, where the heat generated in the electricity-production process is emitted into the environment, CHP units make use of much of the heat. Thanks to cogeneration, end users save about 40 percent in fuel costs. Cogeneration units have a total efficiency of around 80 to 90 percent, while efficiency in a standard power plant (nuclear or coal-fired) is only 32 to 50 percent, depending on the generator.

Another advantage of CHP units is their decentralization. They are placed at or near the point of consumption, saving on transport costs and effects. Cogeneration units thus help reduce damage to the environment, in particular CO_2 emission levels.

CHP units can be successfully used in all buildings with year-round demand for heat and power, and often for cooling.

In Letňany, TEDOM runs five cogeneration units using landfill gas from nearby waste dumps. Karel Kožnar, project manager at TEDOM, discusses the process with Alfa Laval's Eduard Janča.

"We sell energy on the site of consumption or close to it, while central sources have to transport energy via a distribution network to the customer."

JOSEF JELEČEK, GENERAL DIRECTOR, TEDOM

Besides landfill gas, TEDOM has supplied cogeneration units for the Czech mines complex and plans similar installations in Ukraine and Poland, among other countries. When it comes to the future perspective of various "green" sources, Jeleček believes that cogeneration in biogas stations built in agricultural facilities and mine gas utilization are likely to expand even more, and he sees great potential in these areas.

A main driver for cogeneration is legislation restricting CO_2 emissions. In Europe, for example, all advanced countries with a GDP per capita above 50 percent of the EU average, including the Czech Republic, will have to buy carbon credits for CO_2 emissions after 2013. Meanwhile, the United States is likely to pledge to lower CO_2 emissions, and the big Asian powers such as China are beginning to realize the necessity of sustainable development in industry. "This is why I can see the future development in this area as very promising," Jeleček says. ■

TEDOM HOLDING

Established: 1991
Location: Třebíč, South Moravia, Czech Republic
Number of employees: 600
Major production areas: Cogeneration (combined heat and energy production), bus production (urban/suburban, powered by diesel or natural gas), combustion engine production, energy (heating systems, biogas utilization in energetics)
Main markets: EU, Russia
Annual turnover (2009): EUR 74.2 million.
Awards: TEDOM was listed among the best 100 companies in the Czech Republic by Comenius, a pan-European society for culture, education and scientific and technical cooperation. Josef Jeleček, part owner and general director, received the "Businessman of the Region" award in 2007.

First-class cleaning of wastewater

Loïra opts for MBR solutions and the Alfa Laval MFM Hollow Sheet Membrane.

FOUR QUESTIONS FOR JACQUES DEBUIRE, managing director at French wastewater treatment plant designer and builder Loïra.

Why did you choose a membrane bioreactor (MBR) solution for the Bassussarry wastewater treatment plant?

"Because the outfall of treated wastewater at Bassussarry flows into a river where there is a lot of sporting activity. Also the river is a resource for drinking water production, so having the cleanest possible treated water was absolutely fundamental. This was only possible through an MBR treatment solution.

"The quality of the outfall is extremely high, and the system is reliable, easy to operate and simple to install. Moreover, when legislation regarding the removal of traces of xenobiotics such as prescription drugs or pesticides from treated water is introduced, MBRs will be indispensable prior to installing any system to remove them."

Why opt for an Alfa Laval MFM Hollow Sheet Membrane for the project?

"Alfa Laval membranes are gravity operated, so fouling is reduced to a minimum, as the pressure is much lower across the surface. They are very simple to install, can be cleaned in place and are unaffected by the chlorine used in periodic cleaning phases.

"Another key driver in our choice of Alfa Laval is the level of service. The upgrading of the Bassussarry plant was a dynamic three-way project between our client, ourselves and the supplier, and we all worked very closely together, which made it a real success. You can't put a price on a strong and dependable relationship with your key suppliers."

With hindsight, are you pleased with the installation?

"Ten months on and everybody is very happy, from the local authority to the engineers and from the constructor to the operator. The solution is so efficient that in the latest analysis of treated water outfall, all key measurements were well below European norms, and biological analysis showed a total absence of bacteria. This means the plant can sell that water to a nearby golf course for watering, and there is absolutely no harm done to the local environment."

Would you use Alfa Laval membranes again?

"We currently have eight ongoing projects using Alfa Laval membranes. An MBR solution is always our first choice, both for its efficiency and because it makes sense regarding any future legislation, and Alfa Laval is offering the best product that is best adapted to current market needs."

ANNA MCQUEEN

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!

ALFA LAVAL

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