VAHTERUS

Global Challenges Drive Innovation

Novel biotech concepts are supported with engineering expertise at Pannonia Bio

IIAR President Dave Rule: Future of refrigeration is an exciting one full of change

HOT&COLD

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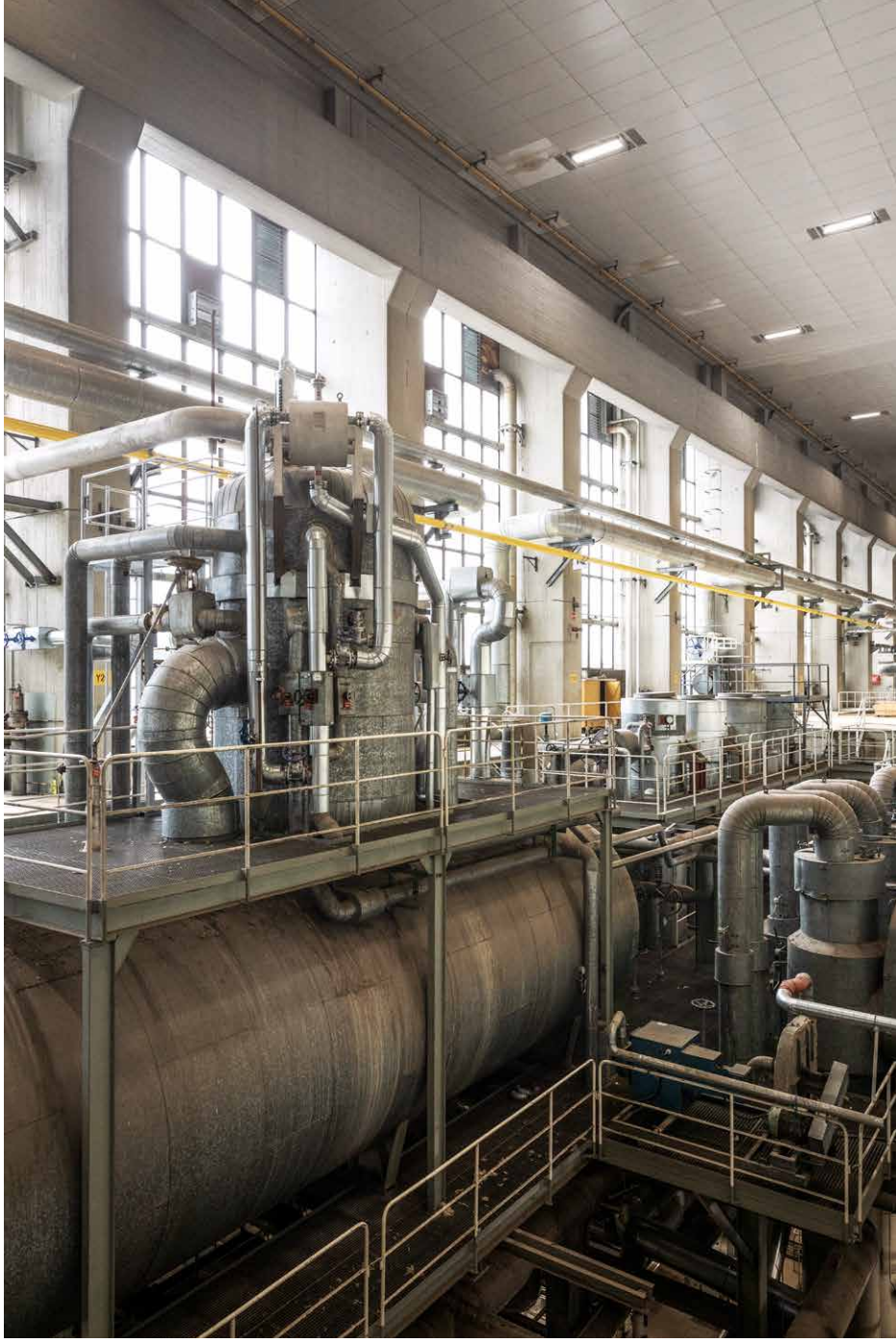

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ON THE COVER

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Vahterus steam generator photographed at Pannonia Bio's ethanol plant

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Pannonia Bio's biorefinery in Dunafoldvar, Hungary

Photography:
Anton Sucksdorff
(except pages 33 and 34)
Image on page 7 by Nico Backström

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Dear Partners, Why Vahterus?

In this editorial, we look at our company's background, its recent developments and our future outlook.

A little history

In the late 1980s, we began to develop a completely new type of heat exchanger. This effort was based on the work experience that I had gained from the design and manufacture of gasketed plate heat exchangers. We wanted to see if it was possible to integrate and combine the Shell & Tube heat exchanger's tolerance of pressure and temperature with the superior heat transfer qualifies of a Plate & Frame heat exchanger. The aim was to create a new-generation heat exchanger construction that would be suitable for a wide range of applications. This development work resulted in the first fully welded Plate & Shell heat exchanger. This key innovation – the fully welded plate pack enclosed in a strong pressure vessel tube – eliminates the need for a gasket and creates a structurally durable heat exchanger that is both compact and safe.

Vahterus Plate & Shell heat exchangers have extensive applications within the chemical and process, energy and refrigeration industries. Our technology has evolved over the years in collaboration with you, and our progress is the fruit of this cooperation. The current year has been one of exceptional growth. Our order books have greatly expanded and we have reached the landmark of 300 employees. We thank you for this, our valued partners.

Our aim

Since the beginning, our mission has been to provide the best heat exchanger solutions for our customers. We have manufactured more than 50,000 Plate & Shell heat exchangers around the world. Only 5% of our products are sold to Finnish clients annually, while 95% go to export. Our strategy to pioneer heat transfer governs everything we do. To achieve this, we need to continue learning about heat transfer and the production of heat exchangers.

We are seeking future growth through investments in new production facilities and machinery. A key development area for us is digital technology, of which we are making use to improve the efficiency of our customer service and order delivery processes. Growth also requires the development of new products and solutions. In this magazine, we present some of our recent product development work, including the new size 12 PSHE.

What's next?

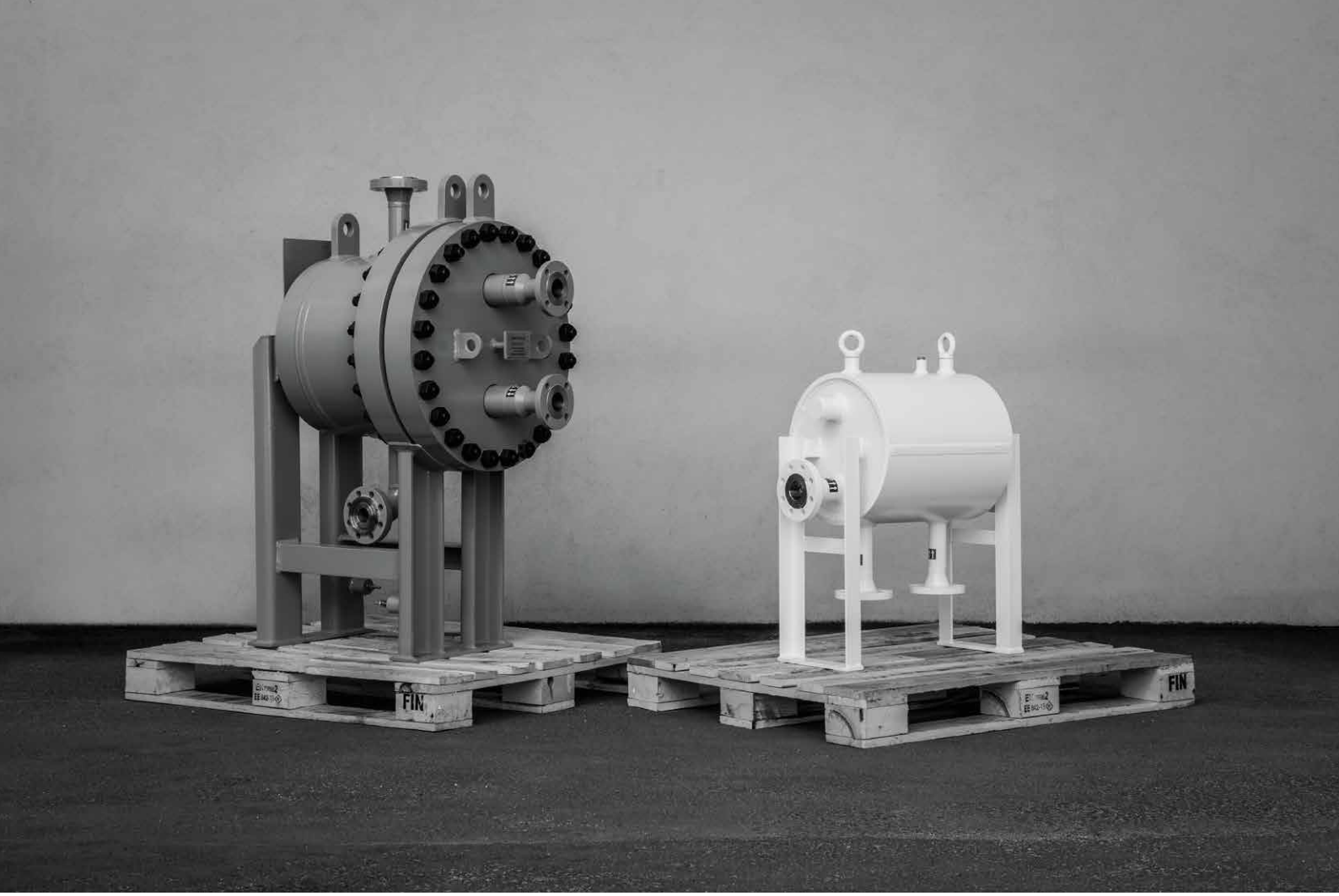
The world is changing faster than ever and technical sectors are increasingly embracing environmental values. I would like to offer my special thanks to **Dave Rule**, President of the International Institute of Ammonia Refrigeration (IIAR), for the article he has written for this issue. He analyses the increasing use of natural refrigerants in refrigeration processes and sheds light on the benefits and significance of this trend in relation to the environment.

For those of us working at Vahterus, Rule's message inspires great belief in the future. To be able to grow, we must ensure that our operations are technically and economically competitive, and that our customers want to use our products for a long time to come. Our work together with you will continue to build a better, more sustainable future for the next generations.

Together we succeed!

Mauri Kontu
CEO, Vahterus Oy

Mauri Kontu, founder and CEO of Vahterus, photographed in Kalanti, Finland.



Vahterus extends its product portfolio with the size 12 Plate & Shell Heat Exchanger.

Research & Development

Vahterus Introduces Size 12 Plate & Shell Heat Exchanger

Valtteri Haavisto, Customer Service Director at Vahterus

PSHE 12 offers a large heat transfer plate with the traditional round shape and corrugation angles. The diameter of the plate is close to 1200 mm and the portholes are DN250. Size 12 fills the gap between sizes 9 and 14. The standard internal diameter of the shell size is 1370 mm. The corrugation angles of the size 12 plate follow the tried and tested shape of size 9. Both HH and LL corrugation angles are available, which provide excellent heat transfer. Another great advantage of the size 12 is the wide range of applicable materials, such as stainless steel, SMO254, Duplex and titanium, to name a few. Size 12 will be available in plate thicknesses 0.7 – 1.5 mm.

Size 12 will have pressure classes of 6, 10, 16, 25 and 40 as standard solutions. Other design pressures can be made on request. The maximum available design pressure will depend upon each specific case.

The high heat transfer of size 12 makes it a very competitive product in heavy-duty heat recovery applications, but it is also an option in all liquid-to-liquid, condenser or evaporator duties. Potential applications are feed-effluent exchangers, steam condensers, heat-pump condensers and large evaporators.

This newcomer will be available for sales after the sizing programme update in August 2019. First deliveries will be made in early 2020.

The slim plate was introduced into the Vahterus plate family in spring 2018 and is now being delivered to customers. Manufacturing lines are proven, and full-scale production is already possible. Plate type 5SH is currently available, but other shapes and sizes can be easily be taken into production in the future. The slim plate is an ideal solution for gas cooling and heating.

Vahterus Service Available

Valtteri Haavisto, Customer Service Director at Vahterus

Vahterus Service can offer a Performance Check of existing heat exchangers. Tests can be done either in-house at Vahterus facility or on site.

Site tests are made together with the customer to validate the condition of the heat exchanger. Vahterus can assist with flow metring or other measurements if required. Typical site-visit validation includes a visual inspection of the unit, performance analysis and recommendations for the future.

Site visits can be made either when commissioning or after several years of use. Sometimes it is a good idea to return the unit to Vahterus for a thorough check. This inspection always includes a visual examination, a pressure-drop test and a helium-leak test. Openable units are inspected internally and flow directors changed if needed.

It is possible to perform mechanical and chemical cleaning of the units at the Vahterus factory and the cleaning result can be validated through a pressure-drop test before shipment.

The Performance Check is only one of many services that Vahterus can supply. We are available to carry out repairs on site or in-house, as well as the supervision of all types of activities involving Vahterus heat exchangers.

Vahterus also stocks ready-made heat exchangers that can be rented by the customer.

The rental period can range from a week to several months. There are 23 models available. Details are available from Vahterus sales on request. Rental services are currently available only inside the EU.

High-pressure water cleaning of a plate pack at Vahterus manufacturing facilities in Kalanti, Finland.

Vahterus test laboratory was installed in Naantali in 2014. The laboratory is unique in terms of capacity, which at 10 MW is not easy to achieve outside a power plant setting.

Everyone Benefits from Smart Cooperation

Vahterus tests its products at a steam laboratory installed in the Naantali power plant of Turun Seudun Energiantuotanto (TSE), an energy production company in the Turku region. The test laboratory, which has exceptionally high capacity, is used to study the qualities of Vahterus steam condensers for product development purposes.

Vahterus Editorial Team

The cooperation between Vahterus and the power plant began with a discussion between **Tapani Bastman**, former CEO of TSE, and **Mauri Kontu**, Founder and CEO of Vahterus, about challenges in product development.

Vahterus products are frequently installed in power plants, and continuous testing is required. TSE wanted to provide an innovative Finnish company with a platform for improving and developing products in a way that also benefits the energy industry.

In 2014, Vahterus leased a facility for a steam laboratory in the Naantali power plant. The plant also provides Vahterus with the steam necessary for testing. The laboratory is unique in terms of capacity, which at 10 MW is not easy to achieve outside a power plant setting.

The power plant's automated system regulates the steam used in testing and the heat recovered from it is transferred to Turku Energia's district heating network. This ensures that nothing goes to waste. Through the collaboration, TSE receives more and more information about heat exchangers and gets an opportunity to participate in product improvement.

'This is a special collaboration project, and the power plant's employees have been participating actively and enthusiastically in operations related to the placement, piping and use of the laboratory. We seldom have an opportunity to be involved in this type of product development', says **Harri Blom**, Development Manager and Operation Supervisor at Turku Energia.

The steam laboratory mainly tests steam condensers to improve their structure and thermal qualities and

'This is a special cooperation project, and the power plant's employees have been participating actively and enthusiastically in operations related to the placement, piping and use of the laboratory. We seldom have an opportunity to be involved in this type of product development.'

Along with the facility, the power plant provides Vahterus with the steam for the laboratory. The plant's automated system regulates the steam used in testing and the heat recovered from it is transferred to Turku Energia's district heating network. This ensures that nothing goes to waste.


AEG

Vahterus products are frequently installed in power plants, and continuous testing is required. The laboratory mainly tests steam condensers to improve their structure and further develop Vahterus's sizing programme.

Continues from the previous page

further develop Vahterus' sizing programme. The laboratory also produces valuable information about desuperheaters and control systems, as well as the durability of condensers in various process conditions.

The practical work is long-term and requires a great deal of planning and preparations outside the laboratory. Although minor progress is continuously being made, major breakthroughs in product development require years of work, failure and success. However, TSE trusts that the cooperation will result in better heat exchangers for its benefit over the long term.

'Our interaction with product development at Vahterus will also facilitate cooperation in the future, when power plant processes are developed further and carbon-neutral solutions are needed. Power plants have a large number of heat exchangers, and various heat recovery solutions are rapidly becoming more common', Blom points out.

TSE is an energy producer operating in the Turku region. Its largest shareholders are Turku Energia (39.5%), a company owned by the City of Turku, and Fortum (49.5%). The remaining shares are divided between the cities of Raisio, Kaarina and Naantali.

Failure is the Seed of Success in an Innovation-friendly Environment

The Vahterus R&D team comprises six people whose goal is to identify potential problems in existing heat-exchanger solutions and find ways to improve products. Successful product development requires perseverance, an understanding of product properties and a curiosity regarding new experiments.

Vahterus Editorial Team

Maintaining the competitiveness of a company necessitates continuous research and development, and Vahterus has decided to make major investments in this area. Everything boils down to developing existing heat-exchanger solutions and understanding customer processes. If you are unaware of customer needs, it is impossible to spot the features that can be improved and the ways in which this can be done.

The Vahterus R&D team is part of the company's Customer Service department, which includes the Quality team. The department is directed by Customer Service Director **Valtteri Haavisto**, who is responsible for the customer interface.

The R&D team consists of six people, all of whom have a specific area of responsibility. Three of the team members are R&D engineers. **Kerttu Kupiainen** runs the operations of the R&D laboratory; **Kalle Vähätalo** is responsible for computational fluid dynamics and mechanical testing. Both also support the sales department in matters related to product sizing. **Reima Viinikkala** focuses on structural design. **Juha Karhu** and **Lauri Rantasalo** construct the testing equipment needed in the R&D laboratory and conduct the agreed tests.

The Director of the R&D team is **Jyrki Sonninen**, who has been involved in Vahterus product development since the early years of the company. He is also responsible for developing the sizing software. 'We analyse the results we obtain from measurements and flow simulations as a team, and then apply the results to developing our software', Sonninen says. The team meets at least once a week, and more often if necessary, but most of the time each member works independently.

Lauri Rantasalo has worked at Vahterus for two decades and has developed his skills in several different positions. He joined Vahterus after his military service through a metal industry recruitment course. At the time, he had completed a vocational degree in electric power engineering.

'I started off welding up small holes and went on to gain experience in various positions, from operating a robot line to pressure testing, during my first ten years at Vahterus. Then I ended up in the R&D laboratory, which is

still my main place of work. My duties also include on-site maintenance and repair work. Last summer, I graduated from the Mechanical and Production Engineering Degree programme of Satakunta University of Applied Sciences', Rantasalo says.

Decisions on research projects to be conducted by the R&D team are made jointly by the R&D Director and the Customer Service Director. In very large projects, decisions are made by the executive team. Projects can be roughly divided into two categories: general research and product tailoring. The latter enables Vahterus to develop heat-exchanger solutions for specific customer needs.

'A typical development project may include investigating how an existing product could be improved by applying a new, alternative structure', Sonninen says. As an example, he mentions an alternative structure developed for a Combined-type flooded evaporator. The development initiative came from a customer who needed a more compact solution.

'Once we'd decided to include the project in our agenda, we began to investigate how it could be implemented, built a test exchanger and tested it in our R&D laboratory. After the structure of the product had been decided, it was time to productise the new solutions: the parts were designed, instructions were provided for product design and the new solutions were imported into the sizing software. In total, the R&D project took a couple of months to complete', Sonninen says.

'Once we'd decided to include the project in our agenda, we began to investigate how it could be implemented, built a test exchanger and tested it in our R&D laboratory. After the structure of the product had been decided, it was time to productise the new solutions: the parts were designed, instructions were provided for product design and the new solutions were imported into the sizing software. In total, the R&D project took a couple of months to complete.'

For Vahterus, investing in R&D means close cooperation with universities and institutions of applied sciences. Kalle Vähätalo, M.Sc. (Tech.), studied energy technology and ended up working in the Vahterus R&D team through one of these collaborative projects. Vähätalo has worked at Vahterus since 2014: he began his career as a Master's thesis worker and moved on to his current position as R&D Engineer in January 2015.

According to Vähätalo, the most challenging aspect of his work is that the problems being examined are so complex. However, this is also what makes the work interesting. To succeed in product development, you must understand the special characteristics of each sales sector and take them into account in your decisions.

'The job requires comprehensive knowledge of heat transfer and flow technology, as well as an understanding of the customer's processes. I also need to master the use of flow simulation software', Vähätalo says.

The day-to-day work of the R&D team is more interesting and the problems more wide-ranging and complex than one might think. An end result that seems simple may require an immense amount of hard background work. Vahterus also receives praise for its innovation-friendly atmosphere.

'We're pretty bold in testing new ideas. Sometimes, we even conduct experiments we know or believe will fail. The purpose of these experiments is to provide us with more information that may prevent us from making a mistake in the future or give us something to spark a significant new project', Rantasalo says.

The R&D team believes in the unique nature of Vahterus products and that the company's main competitive advantage stems from its history. Since Vahterus developed its welded Plate & Shell Heat Exchanger from scratch before introducing it to the market, the company has experienced the entire R&D cycle with all its errors and insights. This is a great starting point for creating new products and developing product improvements.

'As far as we know, we're still the only manufacturer that's seriously developing, measuring and researching Plate & Shell heat exchangers', Sonninen concludes.

The Vahterus R&D team consists of six people, all of whom have a specific area of responsibility. Pictured here, from the left, R&D Engineer Kalle Vähätalo, R&D Director Jyrki Sonninen and Service Specialist Lauri Rantasalo.

Transformations in Refrigeration Industry Rules and Technology are Helping to Boost Innovation

Dave Rule, President of IIAR, which advocates for the best refrigerants available to support an efficient and healthy food supply and a clean and safe environment, explains how the industry is adapting to harness new markets and embrace new operational challenges.

Dave Rule, President of IIAR

The Future of Refrigeration

As the president of the IIAR, I'm often asked what I foresee for the future of refrigeration. The question is complex because there are so many elements and aspects of this industry to consider. But what I can say, simply put, is that the future is an exciting one full of change.

To assess what the future holds, it's crucial to look back at what we've seen occurring in the industry from past to present and how regulatory changes and technology have helped catapult innovation.

The Impact of Regulatory Changes

I've witnessed more transformations in this industry during the last six to eight years than I've seen in my entire career, particularly regulatory changes. The IIAR was formed to advocate for what are believed to be the best refrigerants available to support an efficient and healthy food supply and a clean and safe environment for the world we live in. That's still our mission, but our focus must also address the changes in the industry over time.

To begin to understand many of the issues that are driving change and regulatory impact, one should start with the implementation of the Montreal Protocol and the phase-out of HCFCs (hydrochlorofluorocarbons), more commonly known as R-22. Having identified R-22 as a major contributor to ozone depletion, regulations were put in place by many countries to gradually end its use as a refrigerant. This was accomplished in the US through the EPA's SNAP programme and by other countries through their own government regulatory agencies.

These regulatory changes led industry to search for a replacement refrigerants that would be compatible with existing systems while meeting refrigerant performance requirements for broad applications, low flammability and other safety needs. The result of this search was the introduction of a number of refrigerants known as HFCs (hydrofluorocarbons). These successfully eliminated the chlorine component, which resolved the ozone-depleting issues, but were later identified as a contributor to the greenhouse effect due to their high global warming potential (GWP).

In response to the global warming concerns, the Kigali Amendment was later introduced to modify the Montreal

Protocol and provide a mechanism to regulate the use of HFC refrigerants. The 2016 agreement brought together 170 countries in Rwanda to develop an agreement to begin the phase-out to control the use of HFC or high GWP refrigerants and ultimately safeguard the environment.

As a result, in Europe, the F-Gas regulation has been very effective in implementing the decreased use of several HFC chemicals in refrigeration and other industries. In the US, the regulation of HFC refrigerants has been much slower due to the current administration's reluctance to sign on to the Kigali Agreement and due to the court's decision to limit the EPA from developing regulations to phase down the use of high GWP refrigerants. However, individual states are moving forward through the US Climate Alliance to implement their own state regulations to eliminate the use of HFC refrigerants in support of the Paris Climate Agreement.

The efforts to ban HFC refrigerants, to include, but not limited to R-134a, R-404A and R-410A, called for a phase-out by 2100.

How did and does the Kigali agreement continue to impact our industry?

How the World Approaches Rules and Regulations on F-Gases

The Kigali agreement set standards for countries to ultimately phase out HFC refrigerants completely, but regulatory changes were met with some resistance. However, the European Union has adopted two legislative acts that directly affect the refrigeration industry and are designed to control emissions from F-gases.

Put into effect at the start of 2015, F-Gas regulations set forth by the EU differed from previous regulations in the following manner:

- The regulations limit the amount of certain F-gases that can be sold, ultimately cutting the use by 2/3 by 2030.
- F-gases cannot be utilised in certain types of equipment, commonly used in supermarkets, homes, for AC units and more, when less harmful and more natural alternatives are available.
- The regulation requires proper servicing and checks of equipment to prevent emissions of F-gases.

These changes have quickly filtered into the US, beginning with California's establishment of Assembly Bill 32. The regulations set forth in California are intended to phase down the use of HFC refrigerants at the state level, and support the rules established by the EU F-Gas regulations and similar regulations proposed by the US EPA. 24 other states in the US are now considering similar regulatory actions to support the phase-out of refrigerants with high Global Warming Potential. All of these regulations are currently driving the change in refrigeration-system design and the consideration of replacement refrigerants that will achieve regulatory compliance in the future.

So, what are other considerations that are impacting refrigeration regulations?

CFATS: An Overview

Standards across the world are evolving at a rapid pace and must take into consideration the growing threat of terrorism across many regions of the world. In January 2019, President Trump signed legislation to extend the authority of the Chemical Facility Anti-Terrorism Standards (CFATS) programme, but not without controversy. There are concerns about the effectiveness of the CFATS programme, administered by the Department of Homeland Security (DHS), and even about new legislation that proposes to require compliance costs for the government and the industry and provide incentives for facilities participating in a DHS-recognised industry-run security programme.

The launch of the CFATS program in 2006 was designed to enhance security at facilities in the United States with certain chemicals and to reduce the risk of terrorist attacks targeting chemical facilities. Its focus is on overall safety in contrast to other regulations facing the ammonia refrigeration industry, which primarily focuses on human and environmental safety. Other countries may be forced to follow with similar regulations, given the increasing threat of terrorism throughout the world.

The regulation puts into place security measures for facilities producing chemicals of interest, which add up to more than 300, including ammonia. Each facility is required to file a Top Screen once they reach the threshold quantity, and the DHS then determines the level of security risk present. As a result, once organised into risk tiers, facilities are required to develop site security plans to address the standards set forth by the regulation.

Since the programme began, ammonia has been deemed a chemical of interest, which directly impacts the refrigeration industry in the US. Over time, however, ammonia facilities classed as high-risk have become few

Research is central at the IIAR. Each year, the Board considers new research projects that build on current technology and provide the science necessary to ensure for best engineering practices, regulations and standards that offer greater safety for the refrigeration industry.

and far between. But, with changes to the regulation's methodology, an increasing number of ammonia facilities are now being placed into more high-risk tiers, raising questions about how ammonia is ultimately viewed by the DHS.

This has led to a push from IIAR to ensure that ammonia facilities are being evaluated in the most appropriate manner. IIAR and its members view facility security as a top priority for all plants located around the world. In the US we maintain the same focus but advocate for a reauthorisation of CFATS and similar regulatory programmes in other regions in order to maintain policy environments that are positive, consistent and predictable. This is why ongoing dialogue with regulatory officials in all countries is an important consideration when predicting the future of refrigeration.

Seeking Innovative Solutions

With legislation and regulations in flux, refrigeration professionals have continued to seek out the next sustainable and economic refrigerants to use on a worldwide basis. Chemists have been developing new synthetic refrigerants but are also looking at natural components that won't harm the environment.

Many refrigeration systems utilising the ozone-depleting R22 remain in place and will soon need to be replaced with compatible refrigerants that are compliant with the new regulations. Those facilities that have been converted to the HFC refrigerants are now considering new refrigerant replacements to address global-warming concerns.

In response to the phase-out of the HCFC and HFC refrigerants, chemical companies have introduced a new family of hydrofluoroolefins refrigerants termed as HFOs. A couple of examples of the HFO refrigerants would be R1234yf and R1234ze(E). These new synthetic refrigerants require a complex chemical reaction of their basic components resulting in a blended refrigerant with lower GWP characteristics. However, as with most refrigerants, there are drawbacks that must be considered in each application. Due to their inherent complex manufacturing process, the HFO refrigerants tend to be very expensive, making them less economical to use in larger-volume systems such as industrial food-processing applications. HFO systems are also very susceptible to leak contamination due to air and moisture being drawn into the system. This may result in oil degradation and acid formation that could damage compressors and other components. Moisture freezing in expansion devices may also be an issue.

There are also growing concerns about environmental issues and the flammability of HFO refrigerants. HFOs, by their chemical nature, break down in the atmosphere easily. One of the resulting chemical components is known as trifluoroacetic acid or TFA. This chemical is a concern due to its potential to contaminate the fresh water supply as it is washed by rainfall from the atmosphere. Reports are beginning to emerge of countries monitoring the increased levels of TFA in drinking water and other freshwater systems. Increased flammability issues are also a concern when applying HFOs in the typical commercial comfort cooling and refrigeration applications. Refrigeration professionals and scientists are attempting to address these issues by modifying the blends with the addition of other fluorine component refrigerants that will reduce flammability, but this also increases the GWP. These issues must continue to be addressed in order to consider the HFOs as a viable refrigerant to meet application needs and compliance with both environmental regulations and safety standards.

At IIAR, we promote the safe and efficient use of ammonia and other natural refrigerants. We realise, though, that ammonia does have its drawbacks. While it is cost-effective and efficient, it is mildly flammable and considered toxic. Carbon dioxide is another viable option. These are natural refrigerants and chemicals that will not damage the environment should they be released into the atmosphere. Ammonia has 0 Global Warming Potential and 0 Ozone Depleting Potential. CO_2 has 0 ODP and 1 GWP.

The bottom line as we look to the future of refrigeration is to understand that changes come quickly, and we're evolving along with them. We're adapting to meet regulatory changes, harness new markets, embrace new operational challenges and move into different environments. These efforts help us to re-energise the traditional industrial application of ammonia and CO_2. It has prompted us to open our doors and our minds to non-traditional and new natural refrigerant applications.

Adopting New Technologies

Technology has had the most drastic impact on the future of refrigeration. Design methods have improved and we're now able to design systems with less refrigerant, lowering the regulatory burden, particularly for natural refrigerants, and allowing for more sustainable refrigerants to be used.

The production of new products involving components that allow us to design systems with less refrigerant is an exciting development. Larger ammonia facilities are now taking advantage of new engineering methodology and equipment-design innovation that will significantly reduce refrigerant charge thus mitigating the regulatory burden and improving safety for employees and the surrounding communities. Many of the new system designs also result in improved efficiency for the refrigeration operations and less electric demand on the grid, resulting in an even more positive impact for our environment.

The introduction of small, low-charged units provides new opportunities for manufacturers and refrigeration engineers to design, build and ship packaged systems, isolating small charges. This offers the best of both worlds for our industry. As the equipment manufacturers continue to ramp up their production facilities and our technology continues to improve, we will see the cost of these products becoming more competitive with traditional synthetic refrigeration systems and this will result in natural refrigerants receiving greater consideration in more applications. In the past, we didn't have this option, and technology has offered innovative solutions to keep our industry productive and compliant with regulation.

Improvements in technology have also led to the secondary loop design that improves efficiency and lowers energy costs. We're seeing these types of transitions across the world. Just one look at the supermarket industry shows that low-charge ammonia packages with secondary loop systems are gaining popularity, offering improved efficiency and providing regulatory solutions.

Responding to the Changes

The future of refrigeration must involve a clear recognition of the transitions taking place. ARF and IIAR have taken the initiative to get ahead of the game. We're committed to evolving directly with the change in order to support the application of natural refrigerants in new markets, meet regulatory challenges and support our members around the world.

Here are just a few ways in which we've responded to the changes taking place:

- Our organisation has developed ammonia refrigeration management guidelines, known as the ARM-LC. We've worked extensively with volunteer technicians and engineers to develop these technical guidelines and to address change occurring in the commercial and food retail industry.
- We've revamped and updated the existing CO_2 handbook with broad industry-sector support committed to address both the industrial food process industry and the broad applications now moving into the commercial refrigeration sectors.
- The first draft of the new CO_2 safety standard for the industry was completed in 2018 and was opened up for comments and public review in March 2019. This safety standard addresses the design, installation, maintenance and operation of CO_2 systems. The standard was crafted by a balanced committee with individuals of industrial and commercial industries. We hope that this standard will be approved and processed by ANSI within a year.

The future of refrigeration has also led us to a focus on hydrocarbon refrigerants. The bottling and beverage distribution sector and supermarket industry have been considering self-contained low-charge systems using hydrocarbons. European companies appear to be leading this interest, but the US is also weighing these refrigerants as a potential direction. On the regulatory front, the International Electrotechnical Commission (IEC) recently approved an increase from 150 grams of refrigerant per system to 500 grams, further opening opportunities for designers to use hydrocarbon refrigerants in more applications. In response, we've organised a task force to review the use of hydrocarbon refrigerants and develop safety standards to support our industry in all sectors of the globe. This involves expanding the standard of ASHRAE and working with our larger sister organisation to coordinate the development and implementation of a new standard.

Another effort to respond to changes in the refrigeration industry is to reach a broader audience. We're in the process of translating all of our regulatory and standard documents into Spanish.

In addition, conference sessions at the IIAR Natural Refrigeration Conference & Expo in March this year introduced a new track of technical papers, workshops and panels for commercial food and retail distributors. This is an effort to invite new guests to learn about the future of refrigeration and educate existing members.

IIAR partnered with the North American Sustainable Refrigeration Council to compile an agenda that embraced both commercial refrigeration and the traditional industrial market. This, along with the push to advance

safety-standard documents, is a step forward for the industry as we continue to embrace new technology and innovative solutions.

Ongoing Research into the Future of Refrigeration

IIAR, through the Ammonia Refrigeration Foundation, has established goals to provide our members and the industry with deliverables that ultimately help people operate more efficiently and save money. And, with evolving regulations and the introduction of efficient systems and natural refrigerants, the need for research is critical to our growth in the future.

Our mission, as a non-profit research and education foundation, is to identify, fund and implement scientific and educational programmes that are related to the use of all-natural refrigerants and in all sectors of industry. Vahterus, as a member of IIAR and a Trustee level contributor to the Ammonia Refrigeration Foundation has demonstrated its commitment to this mission and to give back to the industry.

The Ammonia Refrigeration Foundation 'Founders Scholarships' provide grants each year to support engineering and science majors who may wish to pursue a career in the refrigeration industry. With the growing need for technically trained people in food-production plants, the commercial food retail industry, equipment manufacturing, contracting and engineering design, the Founders Scholarship programme is available to help new talent prepare to enter the refrigeration industry.

Research is the other corner stone of the Ammonia Refrigeration Foundation. Each year, the ARF Board considers new research projects that will build on our current technology and provide the science necessary to ensure that our facilities will operate safely and more efficiently in the future. These research programmes have covered analysis of refrigeration insulation procedures and practices, the science necessary to properly size ammonia piping for systems to reduce installed cost and ensure the most efficient system operation, as well as CFD analysis of ammonia release to determine improved warning and safety procedures.

We believe that providing our end-users with transparent data is the key to a successful research and education foundation. And since each new research proposal is vetted, approved and executed, we're learning that the future of refrigeration isn't always something we can predict. What we can predict, though, is that change is inevitable and through adoption of safety standards, improving education programmes and embracing new technologies, we can continue to operate effectively to promote our mission, protect our environment and catapult operations into the future. IIAR will continue to advocate for best engineering practices, regulations and standards that are fair to our members and that offer greater safety for our industry.

In closing, the one factor that remains certain is that the refrigeration industry will continue to see dramatic change over the next several years in response to a new regulation, improved engineering methods and new equipment technologies. The growing need to address environmental issues will drive the search for refrigerants that will achieve regulatory compliance and safety standards moving into the future. Through the implementation of consensus-based safety standards and technological advances, natural refrigerants will continue to offer solutions to address regulatory compliance and safety issues for a broad sector of our industry worldwide.

'The growing need to address environmental issues will drive the search for refrigerants that will achieve regulatory compliance and safety standards moving into the future. Through the implementation of consensus-based safety standards and technological advances, natural refrigerants will continue to offer solutions to address regulatory compliance and safety issues for our industry worldwide.'

A Little Stress Can Be Rewarding

Laser-cutter Ilari Pietilä believes that a little stress improves concentration and performance. He thrives on decision-making, positive feedback and meeting seemingly impossible deadlines.

What is your work history at Vahterus?
I came here nearly eight years ago. I joined the company in summer 2011, after having graduated from Novida Vocational College, where I specialised in machinery and metalwork. I completed my final practical training at Vahterus, so the decision to apply for a job here was easy.

What is your job?
I'm the operator on the laser-cutting line in heat exchanger plate production. Before this, I worked on the robotic plate production line and pressure testing.

Can you describe a typical day at work?
Laser cutting involves monitoring, many types of adjustments, quality control and replacing metal rolls. Operating a forklift is also necessary. The laser-cutting line produces hundreds of plates per day. The exact number depends on how many of the four plate production lines are running simultaneously. Sometimes there are more surprising assignments, such as cutting metal sheets. The workload and pace vary depending on the customer. Producing sheets at a steady pace would mean unnecessary storage, which we seek to avoid. However, sometimes we need to predict future orders to manage the workload.

When do you feel you have succeeded in your work?
Positive feedback means you've succeeded. I also feel good when I stay on schedule even at times when it seems impossible.

When are you at your best?
When working under a little pressure. When you have limited time, you have to fully concentrate, and you usually find a way to complete an urgent assignment quickly.

What, to you, is Vahterus's most important value?
For me, it's probably the fact that Vahterus is a Finnish family business and a significant employer in a small town.

If you weren't doing this job, what would you be doing?
Fortunately, I've never needed to think about that.

How do you spend your time outside work?
Doing this and that at home and in the garden. I exercise by going to the gym and for the occasional walk. I also enjoy woodwork and metalwork. For example, I recently made iron handles for an old drawer, consistent with its style. I relax by bathing in the sauna a few times a week.

In the midst of everyday life, what delights you?
My wife knows how to cheer me up.

What has impressed you recently?
12 Rules for Life, a book by **Jordan B. Peterson** – not necessarily an easy read, but a very rewarding one. It consists of twelve rules that may seem quite self-evident, but I recommend checking them out . For me, the most significant insight was that you must take responsibility for your life and work and that you should compare yourself not with others, but with the person you were yesterday.

What do your co-workers not know about you?
As a child, I was encouraged to learn how to play an instrument, and I chose the accordion.

Who of your co-workers would you like to praise?
The operators of the laser-cutting line on the other shift, for their systematic and precise work. And the rest of my colleagues as well. We get along famously.

In his job on the laser cutting line, Ilari Pietilä enjoys working and making decisions independently. Outside work he would like to learn to play the guitar properly. ' can play a few songs, but I haven't practised much recently', he says. Pietilä was photographed in his work environment at Vahterus in Kalanti.

With Imagination and Innovation, Industry Can Tackle Climate Change

The lower cost of renewable fuels such as solar power is impacting positively on the Energy sector, and they may soon be cheaper than fossil fuel. The Chemical and Process industries are focusing on energy integration in cooling and heating. In the Refrigeration industry, Natural refrigerants are the key to tackling environmental issues.

Chemical and Process

Marko Rantala, Sales Director at Vahterus

Many of our customers are currently focusing on environmentally friendly cooling and heating projects of our customers, together with their surrounding industries and societies. The Hungarian manufacturer of bioethanol, Pannonia Bio (see page 27), for example, uses the energy from process steam to produce vapour. A Chinese chemical plant (see page 34) utilises the energy needed to evaporate liquid ethene to cool down its processes.

The need for energy integration grows as we fight against the climate crisis. Process industry offers a huge potential for manufacturing district heating. Larger units, such as oil refineries, create heat energy that could be transported further away. This has recently been researched in Finland, as Helsinki considers energy solutions to replace coal. The Porvoo refinery and petrochemical plants could easily provide 25% of the heat energy that Helsinki requires. There have been several alternative solutions, such as direct manufacturing of district heat using process heat, or indirect manufacturing using heat-pump technology. Diverse expertise and cooperation between different areas of technology are key to finding the best solutions.

Weakening global economic growth is yet to affect the demand on the markets, and investment in the chemical and process industries has remained strong. The reputation of Plate & Shell heat exchangers as reliable and safe solutions has increased their demand. The Vahterus product family grows this year, with the new plates PSHE 12 and 5SH, which are designed especially for energy recovery. Let's continue to do well in the future!

Energy

Tobias Häggblom, Business Manager at Vahterus

2019 has started well in the energy sector. The dive in the price of oil at the end of the 2018 was alarming, but fortunately it seems that all is now back on track. While, at the start of the year, the oil price was close to 40USD, it is now closer to 70USD. With these prices we can expect a stable number of projects. Even if oil production is not the only target, the oil price still has a great impact on investment decisions throughout the Energy sector.

The decreasing price of renewable fuels will have a great impact on the industry in the near future. The price for solar power has dropped as much as 75% since 2009. According to some experts, renewable energy will soon be cheaper than fossil fuel.

The world's demand for gas is not slowing down. This is mainly driven by the demand for cleaner fuel to reduce CO_2 emissions. New-found resources and gas fracking are also keeping the prices at a lower level for users.

China recently signed a contract to invest in a large arctic LNG plant, together with the Russian natural gas producer Novatek. This is only one of several LNG plants being built in the coming years. Germany is also investing in two LNG import terminals, which will be located in Brunsbuettel, Stade or Wilhelmshaven.

The gas sector offer a great opportunity for Vahterus in the energy field. The demand for light-weight, leak-proof construction, especially in offshore installations, makes Plate & Shell a good fit in these applications. Cryogenic applications in particular, where only stainless steel can be used, are offering a major advantage since we can use fewer materials compared to traditional technologies.

Refrigeration

Heikki Oksanen, Business Manager at Vahterus

Environmental issues, and climate warming in particular, were the key themes of the parliamentary elections in Finland in April 2019. The same themes are also provoking discussion in other countries. Many types of measures have been suggested to stop climate change, from banning internal combustion engines and fossil fuels to reducing private motoring.

No-one has mentioned natural refrigerants and their significance for the environment, even though greenhouse gas emissions could be reduced considerably by replacing R134a, for example, with natural refrigerants such as ammonia. R134a has a Global Warming Potential (GWP) factor of 1,430. The GWP factor of ammonia is 0.

All in all, we consume too much. In our era, shopping has become idealised. At the core of consumption is the fashion industry, which generates 10% of the world's carbon dioxide emissions.

Energy savings in industry are not discussed enough, even though there are major opportunities for energy efficiency. Industrial heat pumps with a capacity of more than 25 MW are a good example. Their payback period is usually less than five years.

Saving and the circular economy are powerful tools in mitigating climate change. In many developed countries, the state supports energy-efficient investments. Climate change is also a business opportunity, which can benefit the fields of energy production, industry, transport, housing and agriculture. The hole detected in the ozone layer in 1985 caused people to change their ways – and now it is recovering.

Installed on the roof, the Vahterus steam generator recovers heat energy from ethanol vapour to generate low pressure steam, which is the energy source for Pannonia Bio's stillage evaporation system.

Global Challenges Drive Innovation at Pannonia Bio's Ethanol Plant

Vahterus Editorial Team

Since 2012, Pannonia Bio operates a biorefinery in Dunafoldvar, Hungary. The biorefinery is the largest ethanol plant in Europe, one of the most efficient refineries in the world, and has a mission to mitigate climate change.

According to Pannonia Bio, the production of bioethanol is one of the most cost-effective ways to reduce greenhouse-gas emissions. Since 2011, the average certified greenhouse-gas emission savings of renewable ethanol against fossil fuel have increased continuously, reaching 70% in 2017, reports ePure, an organisation that speaks for renewable ethanol producers in Europe.

Pannonia Bio is constantly improving its processes and is a nursery for the development of new bio-based technologies. From its beginning as a bioethanol producer in 2012, the refinery has almost tripled in size and developed into a multiproduct facility, where nutrition, health, biochemical and fuel bioproducts are manufactured as alternatives to products made from fossil based materials.

'We're always pushing for improvement in operation and efficiency. That's the most fascinating part of this job', says **Michael Healy**, the Principal Technical Consultant of Pannonia Bio, who has been with the company since 2012.

Born in Dublin, Ireland, Healy was always interested in technology as a youngster. In college, he studied engineering and graduated in Mechanical Engineering. After graduate training with Guinness in Dublin, he worked in the oil and gas business in Canada for several years. Most of his career has been spent with GEA in the process industry – breweries, food industry, biotech and pharma industries – with projects all over the world. After a successful international career, he remains eager to learn more, and Pannonia Bio has been the perfect platform.

Located in the heart of Hungary's corn-growing region, close to the town of Dunafoldvar, the refinery processes over a million tons of feed corn annually to produce 325,000 tons of protein-rich animal feed, 500 million litres of bioethanol and 12,000 tons of corn oil. Family farming is a major economic activity in an area that, after the international recession in 2008, was left one of the most disadvantaged regions in Hungary. The plant has made a significant positive social and economic impact on the town of Dunafoldvar by creating new steady jobs, helping to keep skilled labour in place and mitigating selective migration.

Pannonia Bio does business with hundreds of corn farmers and has fundamentally improved their livelihoods. Predictable demand for corn reduces risks and stabilises prices. Research shows that the plant has also contributed to improved payment discipline in the corn market.

'It's wonderful to see a farmer being able to harvest his corn and take it with his own truck to our plant and get paid in a few days' time', says **Mark Turley**, the Founder of Pannonia Bio. The company continuously seeks opportunities to strengthen local partner relations, contributing nearly 500 million euros to Hungary's GDP and supporting over 3,000 jobs, mostly in rural communities.

'The refinery processes over a million tons of feed corn annually to produce 325,000 tons of protein-rich animal feed, 500 million litres of bioethanol and 12,000 tons of corn oil. New technological innovations improve efficiency, minimise waste and reduce water consumption.'

Currently, about 80% of Pannonia Bio's annual ethanol output is used for blending with gasoline employed in transportation. Transportation is the second biggest source of carbon emissions in the European Union, and by 2020 the EU aims to make 10% of the transport fuel of every EU country come from renewable sources such as biofuels.

Fuel suppliers are also required to reduce the greenhouse-gas intensity of the EU fuel mix by 6% by 2020 in comparison to 2010. The EU has set rigorous sustainability criteria for biofuels and bioliquids to ensure that the decrease of greenhouse gas emissions comes without adverse effects on the environment or social sustainability.

Pannonia Bio has met, or out-performed all the EU's climate, energy, feed, water and air pollution standards and regulations. At the plant, new technological innovations continue to be implemented in order to improve efficiency, minimise waste and reduce water consumption. This is also how the collaboration between Vahterus and Pannonia Bio began.

purpose of the unit is to generate 1.2 bar(a) steam using 5 bar(a) ethanol.

After a full year of the new process running, Healy is genuinely happy about the collaboration with Vahterus. The heat exchanger has performed according to plan and working with Vahterus has been effortless.

'They're all fantastic people', he says, 'and that's what makes the difference. Whether it's building a team or finding the right collaborators for your business, once everyone has the proper skillset, it all comes down to people and their attitude'.

Cooperation between the two companies continues, and earlier this year, ten new Vahterus heat exchangers were installed at the plant as part of another process expansion: 'These are much smaller than the big unit installed last year. I'm sure we'll have many suitable heat exchanger applications in the future', Healy says.

In less than a decade, Pannonia Bio has entered a new market and developed into the largest ethanol plant in Europe. The future for Pannonia Bio's business is continuous

'At the time, we were comparing different heat exchanger technologies but the Vahterus design was ideal for this job. It has a fully welded design on the ethanol vapour side and the unit is very compact.'

In late 2017, Pannonia Bio was planning a major change in its existing process, which required a steam generator to recover heat energy from ethanol vapour. In the new process, hot ethanol vapours would be used for boiling hot water to make low pressure steam, which is the energy source for the stillage evaporation system.

Pannonia Bio evaluated different heat exchanger technologies including Shell & Tube type, Plate only and Plate & Shell type, but the 14-week delivery time turned to Vahterus' advantage: the timeframe would have been too tight for the Shell & Tube heat exchanger. Footprint was also limited because the heat exchanger was to be installed on the roof of the plant building.

'The Vahterus design was ideal for this job. It has a fully welded design on the ethanol vapour side and is very compact', Healy explains.

The heat exchanger was purchased in January 2018 and was delivered in April 2018, just in time for installation during the plant's spring shutdown. The 16t steam generator was installed on the roof using a 400t crane. The

improvement in its process, reduced energy consumption and even greater greenhouse-gas savings. The company also intends to further diversify its product portfolio to reduce its dependence on fuel ethanol.

When Healy mentions his long-time fascination with Roman history, it's tempting to look for similarities between the pioneering civilisation and his own mindset and choice of career.

'When the Roman Empire broke down, development not only stopped, but Europe went back in time. The Romans were ahead of their time. They were civilised, innovative and also great engineers. I admire their organisational skills and their ability to globalise ideas', Healy says.

At Pannonia Bio, innovative biotech concepts are supported with engineering expertise to bring them to commercial scale, and the development has been fast. One simple recipe for a success story: start with a good idea, and add in a team of excellent engineers.

Pannonia Bio is a subsidiary of ClonBio Group Limited, an Irish agribusiness headquartered in Dublin, Ireland.

In ethanol production, 30% of the corn kernel is left over and ready to be made into other types of biomaterials. Pannonia Bio will be introducing these to the market in large quantities over the next five years. 'We're always pushing for improvement in operation and efficiency. That's the most fascinating part of this job', Michael Healy says.

LEFT Michael Healy, the Principal Technical Consultant of Pannonia Bio, has been with the company since 2012. **RIGHT** Located in the heart of Hungary's corn-growing region, the biorefinery does business with hundreds of corn farmers and has fundamentally improved their livelihoods. Predictable demand for corn reduces their risks and stabilises prices.

How Fermion Discovered Vahterus: 43 Plate & Shell Heat Exchangers, 18 Years of Collaboration

Ville Kesälä, Key Account Manager at Vahterus

A member of the Orion Group, Fermion is a Finnish manufacturer and developer of active pharmaceutical ingredients (APIs) for Orion and other pharmaceutical companies around the world. With the special expertise and capacity to manufacture high-potency active pharmaceutical ingredients, Fermion is the global leader in some of the products it manufactures. Its plants are located in Hanko and Oulu, and its research and development facilities are in Espoo. The company's turnover is EUR 84 million and it employs 320 people. Approximately 100 of these work in the Oulu plant.

Fermion's chemical plant in Oulu manufactures pharmaceutical ingredients that are used in medicine for cardiovascular diseases, cancer and psychological disorders. Manufacture is input-based, and APIs are manufactured in continuous stirred-tank reactors. The reactor's jacket is covered in pipes that have steam, water or a glycol mixture running in them to heat or cool down the reactor. The process is fully automated and the need for heating or cooling is defined by the product in question.

Heat exchangers heat up or cool down the plant's manufacturing equipment – reactors, filter dryers and dryers. Each reactor requires two heat exchangers, one for heating and one for cooling. During the heating process, glycol water is heated up with steam; during the cooling process, glycol water is cooled with a mix of ethanol and water. A glycol current runs in the reactor's jacket, providing cooling or heat depending on the input process at hand. The temperature varies from –20°C to +150°C. Due to these rapid changes in temperature, the exchanger is subjected to significant temperature shocks, several times a day. Vahterus Plate & Shell heat exchanger technology has a round plate that is designed to endure the stress caused by the rapid temperature changes.

Kai Hassinen, Fermion's Maintenance Manager, came across Vahterus at Achema exhibition in Germany, 2001. Back then, Fermion was experiencing problems with heat exchangers and Hassinen was intrigued by the new heat-exchange technology. 'A salesman demonstrated the construction of the Plate & Shell heat exchanger and what he said about its qualities convinced me', says Hassinen. 'The plate pack isn't welded onto the exchanger itself. That was new.'

Fermion had previous experience with both gasketed and fully welded heat exchangers. Both types had been tested at the Oulu plant with poor success. 'The problem with the previous heat exchangers was their short life span. They were functional for a while and then began to leak', says Hassinen. The innovative product and new approach of Vahterus convinced Hassinen, and Fermion decided to test this new technology. The first Vahterus heat exchanger was installed at the Oulu plant in 2003.

'Ensuring safety is vital in the processes of a pharmaceutical plant. Therefore, the heat exchangers that are part of the heating and cooling systems must be stable. Vahterus Plate & Shell heat exchangers have endured the challenging conditions and Fermion has been pleased with the products and their operation.'

Located in Oulu, Northern Finland, Fermion's chemical plant manufactures pharmaceutical ingredients used in medicine for cardiovascular diseases, cancer and psychological disorders.

Vahterus's Plate & Shell heat exchanger met all the operational expectations and endured the conditions that other technologies could not. Following positive experiences over the years, Fermion has installed more Vahterus products to replace broken heat exchangers in their processes. The latest collective project was the expansion of the Oulu plant in spring, when Fermion equipped its new reactors with Vahterus products. 'At the moment, we're engaged in a renovation project where the heat exchangers of three pieces of manufacturing equipment are being renewed, six new heat exchangers in total', says Hassinen.

The spring project was a natural continuation to Fermion's years of collaboration with Vahterus. Currently, the firm has a total of 43 Vahterus Plate & Shell heat exchangers installed in its processes, of which not even one has started to leak. Hassinen sees no reason why all of the applicable heat exchangers shouldn't be replaced with Vahterus products in the future.

'We're already planning to replace old heat exchangers with Vahterus heat exchangers', Hassinen says. 'We still have seven old machines with old heat exchangers at the plant. All of the old machines will be renewed and 14 new heat exchangers will be installed in the process.'

Ensuring safety is vital in the processes of a pharmaceutical plant. Therefore, the heat exchangers that are part of the heating and cooling systems must be stable. Vahterus Plate & Shell heat exchangers have endured the challenging conditions and Fermion has been pleased with the products and their operation over the years. 'Our experience has been excellent and not a single Vahterus heat exchanger has broken down', Hassinen sums up after nearly two decades of collaboration.

Entering Into Low-Carbon Economy Utilising Cold Energy Recovery

Vahterus Editorial Team

The production of alcohol amines requires large amounts of ethylene. A chemical plant in Eastern China specialises in alcohol amine production. Ethylene purchased from outside is stored at the plant as liquefied gas below –103°C. The production process, however, uses vaporised ethylene gas.

Before the recovery project, the ethylene was heated and vapourised using steam with methanol as the intermediate medium. Not only were large quantities of high-grade cold energy wasted, but the annual steam consumption was also enormous. The total capacity of ethylene vapourised was approximately 3,800 kW, which would cost about 8 million RMB (over one million Euros) per year in heating by steam.

Since glycol cold energy is needed to satisfy the cooling demands of the chemical process, this was an opportunity to utilise ethylene cold energy, which would be transferred to 50% ethylene glycol through propylene condensing and evaporating in the intermediate loop.

Specialising in alcohol amine production, a chemical company installed six Vahterus units to its plant located in Eastern China.

Propylene is a good choice of intermediate fluid to avoid glycol freezing. The cold recovery project could achieve two different cold streams of –30°C glycol and 0°C glycol for another process in which it was used directly. It could also reduce the power consumption of previous glycol refrigeration systems by about 6 million RMB per year.

In the cold recovery innovation, the major equipment comprises an ethylene vaporiser with propylene condensing, and a glycol cooler with propylene evaporating. The operating condition for the heat exchanger was demanding, since the working temperature had to be around –103°C at its lowest and the working pressure up to 38 bar(g). A small temperature approach and high heat transfer efficiency were required, as well as thermal calculating with preheating, evaporating and superheating in the ethylene vapouriser. The structure of the heat exchanger also needed to be robust to ensure stability in the ethylene gas supply.

At the time of the proposal, Vahterus Plate & Shell heat Exchangers had already been proven to bear low temperature thermal shocks and high pressure shocks. In addition, Vahterus had been deeply involved in research and development over the past decades. We had accumulated many thermal calculation experiments and had successfully used a thermosiphon loop for cooling energy recovery. For these reasons, the company chose Vahterus heat exchangers.

Six units were installed in August 2018 and they have been operating since November 2018. The performance of the whole recovery project is excellent. The company has saved steam and power consumption to the tune of about 7.6 million RMB in the past six months. Energy recovery is also a meaningful way to enter into low-carbon economy for sustainable development. The benefits of this very successful heat exchanger solution will be carried over from the present user to the next generation.

Recovery of Heat from Vapour Produces Savings at a Tyre Factory in China

Vahterus Editorial Team

A South Korean tyre manufacturing company has production facilities in Chongqing, China. The manufacturing process requires an air separator for discharging air. In the air separating process, the water supplied to the air separator is heated up to a saturated temperature using steam, and oxygen, carbon dioxide and other gases dissolved in the water are discharged in accordance with Dalton's law of partial pressures.

In a typical case, there is a bleed valve and a pipe located above the air separator tank. Through them, gas and steam are discharged into the atmosphere in the form of vapour. This solution is not ideal, however, since it increases steam consumption. An added downside is the white cloud of vapour which is not something that anyone wants to see exiting from a factory.

Vahterus has delivered many heat exchangers for the recovery of heat from exhaust vapour. Spirax Sarco, a company specialising in steam applications, suggested installing a heat recovery system to the customer. In the proposed system, heat energy recovered from exhaust vapour is used to pre-heat cold feed water before it entering the boiler. The key question was the selection of an ideal heat exchanger.

In this case, the heat exchanger was subject to various special requirements. First of all, it should not prevent any non-condensible gases from being discharged into the atmosphere. It should be small and light so that it would be easy to install above the tank. In addition, its structure should be durable and should not need any significant maintenance, since it would be located outdoors. Finally, the heat exchanger should be easy to fit and install in the current system.

Spirax Sarco recommended the Vahterus Vent Condenser to the customer. This unique product is designed to recover vapour and use its thermal energy to heat process water.

'The new vent condenser quickly proved its worth as a profitable solution. Four years after its installation, the heat exchanger is up and running and, so far, it has not required any maintenance.'

Key benefits of the Vahterus product for the customer:

- Steam inlet nozzle customised to volume of steam
- Small plate size and short distances
- Low pressure losses, no back pressure
- Customised condenser unit size
- Separate exhaust nozzle for non-condensible gases
- Easy to install in the existing system
- Durable welded structure, made fully from round plates
- High efficiency ratio, can be fitted in a small space

The tyre company immediately approved the solution proposed by Spirax Sarco, and it was installed in 2015. Since then, no vapour has been exhausted as waste energy. The Vahterus Vent Condenser increases the temperature of 25°C the boiler feedwater supply by. This provides the company with annual savings of 300,000 Nm3 of natural gas used to heat water, resulting in significant financial savings. The new condenser quickly proved its worth as a profitable solution. Four years after its installation, the heat exchanger is up and running and, so far, has not required any maintenance.

Vahterus Vent Condensers have been sold through an OEM partner in China since 2013. Up to now, hundreds of condensers have been installed in China and Japan.

vahterus.com