VAHTERUS

Two Decades in Refrigeration

Winning collaboration between Vahterus and John Wijbenga

Vahterus refrigeration team combines technical knowledge with premium customer service

HOT & COLD

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ON THE COVER

Front:
Vahterus Ring skiing arena in Uusikaupunki, Finland.

Back:
PSHE Systems photographed at Vahterus manufacturing facilities in Kalanti, Finland.

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Case Stories' imagery provided by case clients.

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Dear Partners, What's Next?

Digital and heat exchangers

The combination of digital and heat exchange technology might sound surprising, but at Vahterus, digital plays an increasingly important role in everything we do as a manufacturer of welded heat exchangers. It's critical in our sizing software, production technology, sales and marketing, customer service and account management, as well as in analysing and monitoring our processes. Today, nancial administration would be impossible without digital technology. Sales and marketing have already moved to digital channels in many industries, but in the heat exchange sector this transformation is still in its early stages.

As such, it is one of our key focus areas for the future. I believe that digital will revolutionise our industry, and help us create new heat exchanger solutions for the next generation. We want to be pioneers in that development together with you.

Is the world getting warmer?

This past summer was exceptionally warm and very dry in Finland and elsewhere in Western Europe. Record high temperatures have been set across much of the world and an unusually prolonged and widespread heatwave has intensi ed concerns about climate change. The heatwave has devastated crops across Europe, leaving some countries facing their worst harvests since the end of the Second World War. Is this evidence of global warming triggered by our actions and by the environmental damage we've caused? A number of long-term studies support this conclusion. Only time will tell.

By developing safe and sustainable heat exchanger and heat transfer solutions, we can help to save our environment and build sustainable development for the next generation. One of the key solutions is applications that use natural refrigerants such as ammonia and carbon dioxide, where our fully welded Plate & Shell heat exchangers are the perfect fit. We will continue to invest in this work and remain active in developing new solutions for refrigeration and heat pumps.

In this issue, our long-term partner and one of our first customers **John Wijbenga** talks about our highly successful collaboration in the refrigeration industry, which we've built over the course of more than twenty years. I warmly thank him, as well as all our partners for the opportunity to collaborate on designing and building safe solutions with natural refrigerants. It's been an incredible journey, and one that is certain to help ensure a stable climate for future generations.

Chillventa 2018

At the Chillventa Fair, 16–18 October 2018, Nuremberg, Germany, we present our latest Plate & Shell heat exchanger solutions for the refrigeration industry. We will be exhibiting in Hall 6 / 6-130.

I hope you come to meet and challenge us there. We look forward to sharing our latest innovations and developing new knowledge with you. As energy saving is becoming more and more important in the fight against global warming, we continue to work on new technologies. It's our responsibility to build a safer future.

Together we succeed!

Mauri Kontu
CEO, Vahterus Oy

Mauri Kontu, founder and CEO of Vahterus, and John Wijbenga, founder of Wijbenga B.V. Netherlands, photographed in Kalanti, Finland.

The original Vahterus PSHE Combined integrates the evaporator and separation system within a single vessel. This fall, Vahterus introduces a new, updated model.

Even more compact, Combined C

Vahterus is actively developing products for the refrigeration industry. This fall, the R&D team introduces a second-generation combined evaporator, Combined C, for even more compact refrigeration packages.

Valtteri Haavisto, Customer Service Director at Vahterus

The Vahterus combined evaporator has been on the market for several years and has been used in various refrigeration systems all around the world. Its original design has been a great success.

The evaporator combines an effective flooded evaporator and a droplet separator in one shell. This system eliminates the need for an external droplet separation drum, thus saving on piping work, insulation requirements and room height.

Vahterus is always actively developing products for refrigeration markets. We have collected information from users and contractors in order to further improve the combined evaporator. This has allowed us to develop our second-generation combined evaporator – Combined C – which will fulfil increasing customer demand for even more compact refrigeration packages.

The Combined C will have an ammonia suction connection on the endplate of the shell. The connection size will be matched to the shell size of the unit. For example, a size 7 shell will always have a DN150 ammonia suction pipe. Another innovation is the location of the ammonia injection close to the outer shell.

The top of the shell is designed so that it will remain free from any connections. This will enable the positioning of other components such as a condenser on top of the evaporator, with only a small space for insulation required between the units.

Customer Service Director Valtteri Haavisto photographed in Vahterus test laboratory in Kalanti, Finland.

Vahterus Research & Development team from left to right: Valtteri Haavisto, Kerttu Kupiainen, Reima Viinikkala and Kalle Vähätalo.

The new Combined C has been designed and tested by Vahterus's Research & Development team. Designer **Reima Viinikkala** was responsible for the intelligent separation system while Engineer **Kerttu Kupiainen** did the test work with her team in the laboratory. As ever, these tests gave rise to new development ideas and thoughts for the future.

Vahterus has not only updated the combined shell sizes, but has also responded to requests from the markets to enable higher ammonia volume fluctuation in the combined units. Our updated, larger combined shell sizes make this higher fluctuation possible, an especially important feature with air-cooled condensers, which can collect ammonia liquid when the ambient temperature is cold, but are unable to retain liquid when ambient temperatures are high.

The larger shell of the 1,000kW water chiller will have 2.5 times higher fluctuation capacity than the standard size combined shell. Further technical details are available from Vahterus sales team. Please see the contact details for our experts in the chemical and process, energy and refrigeration industries at vahterus.com

Simulation Competition for Engineering Students

At Vahterus, university collaborations are an important way to enhance innovation through knowledge exchange.

Vahterus Editorial Team

This autumn, Vahterus is collaborating with Turku University of Applied Sciences and EDRMedeso on a student competition for fourth-year mechanical engineering students. Students will be given the opportunity to test simulation tools by EDRMedeso, a leading provider of simulation software. The aim is to design a simulation solution for an impingement plate that protects heat exchangers from mechanical erosion.

3D simulation is a growing segment of modern product-development work. It allows for designs to be evaluated quickly and cost-efficiently because problems and flaws can be identified early on in the design process without expensive physical prototyping. Using computational fluid dynamics, the students will prepare a 3D model of the heat exchanger and add gas flow and droplet movements to the simulation.

Eero Immonen, Principal Lecturer at Turku University of Applied Sciences, sees this competition as a valuable introduction to the industry. Students will get the opportunity to apply theoretical knowledge to a real-life industry context and demonstrate their competence to potential future employers. EDRMedeson and Vahterus also value the collaboration. "For us, universities are an important source of new ideas and concepts", says **Heidi Niskanen**, Academic Manager at EDRMedeso. "We value collaborations, where students get to test their product-design skills with our simulation software."

Vahterus continuously collaborates with universities, and Turku University of Applied Sciences is a long-term partner. "We see university collaborations as an important way to enhance innovation through knowledge exchange", says Valtteri Haavisto, Customer Service Director at Vahterus. "This competition offers a unique opportunity for students to explore industrial product development and we look forward to seeing the results. Hopefully it will bring new thinking to us, too."

Going the Extra Mile Seals the Deal

Combining technical knowledge with premium customer service, the Vahterus refrigeration team seeks the best custom-made solutions for customers' heat exchanger needs in refrigeration applications.

Vahterus Editorial Team

Customer accounts are shared between key account managers and sales engineers. Everyone is responsible for keeping in touch with their own customers and replying to their requests for quotations. Although each team member works independently, problems are solved together, and during the busiest times, help is never far away.

A typical case begins when a customer contacts Vahterus with a request for quotation. A sales engineer or key account manager then seeks the best solution that can be supplied, within an efficient timeframe. Budget, installation location and available space are common factors that need to be considered. When the structure, price and delivery time of the heat exchanger are agreed upon, an order is placed. Before it goes into production, the person who made the deal reviews the case once more, ensuring that all the details are as discussed.

The case is then handed over to a sales coordinator, who registers the order in the system and is responsible for the delivery of the product all the way up to billing. The sales coordinator also keeps the customer informed of possible changes during the production process.

"The ability to react quickly to changes that come from customers, as well as from in-house, is key in this job", says Sales Coordinator **Anna-Liisa Aula**. She came to Vahterus ten years ago to undertake an internship while studying international trade at Satakunta University of Applied Sciences. After the internship, she was hired in her current position in the refrigeration team.

"There can be rapid changes in the status of a case, especially with deliveries. That's when you need to act quickly and keep the dispatch office, transport company and customer updated of the situation", Aula says.

To be able to work with such a specific technology, the sales team must have in-depth technical knowledge and understand the requirements of the customer's system. They are the link between the customer and the product development team. This is a job you grow into by working hard and earning your success. After the first discussion with a customer, it can sometimes take up to a few years for an order to be placed.

Key Account Manager **Mikko Tuomainen** started working at Vahterus in 2014 after graduating from Tampere University of Technology as a Master of Science. He considers finding a technical and economical solution that corresponds to the customer's need the most challenging – and at the same time, most interesting – part of his job.

In his daily work, Tuomainen seeks to develop existing customer relationships, find potential new customers and increase sales. In addition to keeping in touch by phone and email, maintaining customer relations means travelling to visit them from time to time.

The refrigeration team aims to convene weekly meetings, but they are not always possible because of travel schedules. Still, regular discussions are the best way to keep everyone up to date about current and future events, as well as the market situation.

"With the EU F-Gas Regulation, prices for high-GWP refrigerants have increased considerably, which has

Vahterus refridgeration team from left to right: Matias Lalla, Aleksi Helle, Ville-Veikko Torkkola, Mikko Vilola, Johanna Reinvall, Atte Aarnio, Anna-Liisa Aula, Heikki Oksanen, Anna Ahola and Mikko Tuomainen.

Business Manager Heikki Oksanen knows that more than traditional sales skills, working with a specific technology requires in-depth technical knowledge. "This is a job you grow into by working hard and earning your success", he says.

raised the demand for natural refrigerants and solutions that use them", says Tuomainen of today's market. Another clear trend is the growing demand for heat pumps, for which Vahterus heat exchangers are the perfect fit.

Sales Engineer **Johanna Reinvall** has been at Vahterus since 2000. Before starting in sales ten years ago, she had different roles in documentation, marketing and project management. Like the rest of her team, she approaches sales work with a customer-oriented mindset. "One of our main principles is to take good care of existing customers. We believe in promptness, precision, and we aim to answer queries within a day", Reinvall says.

It takes focus and flexibility to prevent tasks from accumulating when there are a lot enquiries coming in. Going the extra mile delivers the best results. "Whether it's a quick answer to a question, or being able to offer a good price that seals the deal, a satisfied customer is the best reward for the work done", Reinvall sums up.

IIR establishes a working group to promote refrigeration safety

While standards have helped the refrigeration industry to improve and set safety requirements, the International Institute of Refrigeration is proposing a working group to enhance refrigeration safety.

Alexander Cohr Pachai, Technology Manager at Johnson Controls (and Chair of IIR working group)

Over the last 150 years, we have learned how to use a number of different refrigerants. The first refrigerants were ammonia, ethers, methyl chloride, air and CO2. Later, hydrocarbons emerged, and in 1930s we saw the first series of CFCs, mainly R-11 and R-12, emerging on the market, followed by HCFCs such as R-22 and R-502. Of those refrigerants that preceded CFCs, only ammonia remained on the mainstream market, with CO2 and the hydrocarbons disappearing. Ammonia was used in large industrial systems in many countries because it was very energy efficient.

Over the years, accidents happened when working with these refrigerants, but these showed engineers and technicians how to design risk-free systems and work safely with the different fluids. Standards and guidelines helped the industry to set safety requirements.

In the research and development undertaken in order to find an alternative to refrigerants with a high global-warming potential (GWP), the chemical and the industry has found new solutions with low or practically no GWP. However, these solutions come with a price – they are flammable and in some cases toxic. Other refrigerants produce toxic by-products that cannot be broken down by natural processes.

These new refrigerants require new skills from engineers and technicians. The evolution of higher standards must be accelerated if the industry is to meet the goals set by the politicians. Knowledge must be collected through ongoing experience.

For these reasons, we are proposing the formation of a new working group that will speed up the process of knowledge accumulation from the lessons we learn the hard way from experience. The outcome of the working group will be a report describing what we have understood regarding the risks and safety requirements of various refrigerants. The report will need to be updated on a regular basis in order to maintain its relevance and to disseminate the most recent learnings.

Continues on the next page.

"We are proposing the formation of a new working group that will speed up the process of knowledge accumulation. What we learn the hard way can be shared as a lesson for all of us."

The International Institute of Refrigeration IIR proposes a working group to collect and share data on refrigeration safety and describe the lessons learned with various refrigerants.

Continues from the previous page.

Who can participate?

In principle, everybody can feed information to the group. All reports of accidents, their causes and the preventative measures taken to avoid them will be evaluated, compared and categorised. While we prefer participants to be members of IIR, anyone can attend the meetings, including those in fields that do not have the financial means to join IIR. Translations of press stories reporting local incidents locally will provide information that we would otherwise never hear about.

How to get in contact

Information can be sent by e-mail to **Alexander Cohr Pachai**, Technology Manager at Sabroe Factory for Johnson Controls and Chair of the working group, who will lead the work. All relevant information is welcome. Please clearly state the place and date of the accident and if possible the type of refrigerant used. Press reports are not always accurate, so please verify the information contained in them with the local rescue centre. Alexander Cohr Pachai: alexander.c.pachai@jci.com.

Winning Collaboration Between Vahterus and Refrigeration Specialist John Wijbenga

A pioneer in refrigeration, John Wijbenga has devoted his career to understanding and developing systems with ammonia. At 72, he is still an active contributor to the industry and believes that the secret of success lies in carrying out ordinary daily activities unusually well.

Vahterus Editorial Team

Born in the Netherlands, **John Wijbenga** gained knowledge of construction work and material handling early, while working in his family smithy during his school years. He studied mechanics, energy production, controls and refrigeration before he began his professional life as a project engineer in industrial refrigeration, a job where everything he had learned seemed to come together.

At that time, the main refrigerant in industrial refrigeration was ammonia, and the fundamentals for systems with ammonia became Wijbenga's key interest. They have remained so for his entire professional life.

In 1984, Wijbenga started his company, Wijbenga Engineering, which focused on specific-application engineering. The company began as a representative in the Netherlands and Belgium of the well-known German company Th. Witt Kältemaschinenfabrik GmbH. The main products were, and are, pumps, vessels, pump stations and high-pressure float regulators.

During its first years, Wijbenga Engineering supplied a number of ice banks for the wet pad cooling of fruit and vegetables, and the application range quickly grew with products from two other companies, including innovative control valves, solenoid valves and level sensors. In late 1993, Wijbenga saw the Vahterus Plate & Shell heat exchanger in an exhibition and became instantly interested.

"I thought the product could strengthen our portfolio as an alternative for Shell & Tube heat exchangers", Wijbenga says. "We could use our existing knowledge of and experience with flooded systems for it, and fulfil customers' growing demand for low-charge ammonia systems.

Wijbenga returned home and told his colleague he had seen a product that could be of interest for their market in the future. But there had been no name on the products at the exhibition, and with no internet, tracing the manufacturer was difficult. Wijbenga had heard that the heat exchanger came from a small company in the southwest of Finland, and finally, after receiving **Mauri Kontu**'s contact information from the Finnish Chamber of Commerce in Amsterdam, he was able to get in touch with Vahterus.

The first heat exchanger was ordered at the beginning of 1994 and in September that year Wijbenga visited Vahterus in Kalanti to discuss further cooperation between the two companies – a collaboration that has endured ever since.

A more specific purpose of the visit was to talk over the delivery time of the first size 5 heat exchanger, a unit that was supplied to a Belgium customer. It is still in operation as an evaporator to cool down propylene glycol.

Although Vahterus was a small company, Wijbenga saw its potential. "They had an innovative product and an open mind for supporting tests. They also had short lines in decision making and a strong focus on one product type", he recalls. Vahterus was also able to follow market demand through production extension.

It was not long before Vahterus Plate & Shell heat exchangers became very popular in refrigeration solutions in the Benelux, particularly in solutions where they were combined with separators from Th. Witt Kältemaschinenfabrik. With these solutions, Wijbenga Engineering won the Dutch innovation award Koeltrofee in 1997, just four years after their introduction.

Wijbenga believes that the secret of this success lies in doing ordinary daily activities unusually well. "You can't do it alone", he points out. "The most significant thing I've learned during my career is to share knowledge with others, especially with young people, and let them follow education as far as they have an interest in it".

Sharing knowledge, discussing possibilities and testing products together has also been the backbone of the winning cooperation between Wijbenga Engineering and Vahterus, which has resulted in Wijbenga Engineering selling 10% of the produced units for refrigeration applications into the Benelux.

"Over the years Wijbenga Engineering as a company and John Wijbenga personally have had a very important role in developing the Vahterus PSHE technology and in particular, in developing and launching it for different applications in natural refrigeration systems", says Kontu.

Along with building good customer relationships in the Benelux countries, the company has been willing to share with Vahterus their wide experience and know-how of building refrigeration systems. Kontu considers Wijbenga's personal involvement and advice, as well his contribution in the form of extensive hand books and very detailed instructions, invaluable.

In 2001, Wijbenga Engineering made a complete handbook to inform its customers about the dos and don'ts of Vahterus heat exchangers in refrigeration systems. It served as a base for the *Vahterus Refrigeration Hand Book* that was produced later.

In 2010–2011, Vahterus and Wijbenga bound the strengths of both companies together and developed the combined heat exchanger. This evaporator with integrated separator contributes to the attempt to reduce the refrigerant charge. "During a number of practical tests in the Vahterus lab, including some negative results, we all learned a lot and found the best solution", Wijbenga says.

Wijbenga believes Vahterus can maintain its position as a market leader in fully welded Plate & Shell heat exchanger technology through constant development. "Over the last 25 years, you can see an increasing market for this type of heat exchanger. Of course there are, and will be, a number of other heat exchanger types. But Vahterus can play a very important role in this field, as has been proved by the development and results of the combined heat exchanger over the last few years."

"In 2010–2011, Vahterus and Wijbenga bound the strengths of both companies together and developed the combined heat exchanger. This evaporator with integrated separator contributes to the attempt to reduce the refrigerant charge."

He points out that deepening the understanding of PSHEs in detail, and getting to know their characteristics, may not only lead to building better products but even inventing new ones. Wijbenga thinks it is essential to train employees in application techniques and to share product information with customers in order to really understand their system demands. In terms of industry trends, Wijbenga considers charge reduction and natural refrigerants the best bets when building tomorrow's solutions.

At 72, Wijbenga is still working part time in the refrigeration industry at Wijbenga Engineering and in the Vahterus R&D group. He is also active as volunteer in the church of his home village Geldermalsen, especially for technical and building issues.

John Wijbenga, founder of Wijbenga B.V. Netherlands, photographed at Vahterus headquarters in Kalanti, Finland.

New Solutions Take Time to Develop

In order to build a safer tomorrow, both for the planet and for people, industries are creating new technologies and solutions. While change can take time, examples of positive trends can be seen in each sector. The rise of heat and exhaust recovery, for example, has been made possible and increasingly efficient by new product innovations.

Chemical and Process

Marko Rantala, Sales Director at Vahterus

In the previous issue of *Hot & Cold*, I talked about sustainable solutions in the chemical and process industries. This time, I want to talk about the slow process of finding and applying them. Change requires resilience, focus and patience. It happens slowly. Sometimes you need to find some distance, take an outsider perspective, to see it happening. People grow, and knowledge develops. Little by little, words, thoughts and actions change attitudes and suddenly ambitions that once seemed far away become possible. Our experience confirms the validity of our initial ideas, and we're inspired to aim higher, dream bigger.

A growing number of end users are now providing examples of the long-term benefits of introducing Plate & Shell heat exchanger technology to the chemical and process industries. This year, Vahterus gained the status of certified supplier to one of the largest chemical companies. This has required years of focused work. The decision makers in charge of process planning and heat transfer learned the benefits of our Plate & Shell heat exchanger technology. We convinced them of our ability to deliver products that respond to customer requirements, and together we've developed processes and applications for the new technology. After years of consistent work, our collaboration is manifesting itself in new requests and orders.

Another example is a southern European oil company, whose heat exchanger experts recently participated in our sizing training in Kalanti, Finland. Their new understanding of our calculation principles and manufacturing processes has significantly deepened our collaboration.

Energy

Tobias Häggblom, Business Manager at Vahterus

Despite the positive trend in the oil & gas industry, with increased oil prices, the outlook is not as good in power production. The current low power prices have led to reduced investment in combined heat and power plants and to the closure of a number of thermal power stations in Finland.

One of the reasons for the low prices is increased efficiency and the substitution of wind power. In these conditions, cities tend to invest in plants producing heat only, since the cost of a combined heat and power plant is significantly higher than that of a plant producing heat only. From Vahterus's point of view, this means that we should concentrate on smaller plants. Good opportunities can be found, for example, with heat exchangers located between the district heating network and the boiler medium.

With LNG and gas processing on the increase, the timing of the new Vahterus fully-welded S-series is good. Launched at the Achema 2018 fair this summer, our new S-series introduces a slimmer plate model. In gas processing in particular, the new slim plate provides fresh opportunities. Due to its ability to handle high volume flows with low pressure drops, we can now approach applications that would previously have been impossible. The increased length maintains a high pressure drop on the plate side even at low flows. This is ideal for heat-recovery applications. Exhaust recovery is also taking a step forward with the new slim plate. The short length on the shell side allows for low pressure drop and easy cleaning. These features are opening a wide new range of applications and opportunities.

Refrigeration

Heikki Oksanen, Business Manager at Vahterus

This summer, Europe saw above-average temperatures and below-average rainfall, and not a day went by without climate change being covered by the media.

The role of the refrigeration industry has been cited as a cause of global warming, and the industry has sought more environmentally friendly alternatives to replace coolants with a high global warming potential. The alternative solutions need to be politically stable, and availability of the alternative coolants must be secured for decades to come. As such, natural coolants are the only realistic alternative to synthetic coolants.

Heat recovery is gaining momentum and the use of fossil fuels has been limited. Waste heat must, and will be, utilised more fully in the future.

Low-charge ammonia refrigeration systems have gained much attention lately, but they are far from a panacea. The safety of a cooling plant depends on several factors, and it is in everyone's best interest to avoid accidents, fatalities and negative publicity.

The annual main event of the refrigeration industry is the Chillventa fair, which takes place in Nuremberg on 16–18 October 2018. This year, the event's key topics are climate change and natural coolants, and industrial heat pumps are the centre of attention at several seminars.

Our new range of products are on display in Nuremberg. The mission at Vahterus is to find tailored solutions for our clients. To us, this does not only mean modifying our products, but also designing products with a long lifespan, while taking into account the unique needs of a range of processes.

One of our first employees, Juha Suominen, photographed in the village of Vahterus in Western Finland.

Meet Our Team

Improvement is Built on Solution Orientation

Quality Manager Juha Suominen is responsible for the quality development of our products and operations. While he takes his work and its challenges very seriously, he enjoys a work environment where there's also room for humour.

How long have you been with Vahterus?
I started working at Vahterus in 1991, so I've been here for more than 27 years.

What's your work history in the company?
At first, I worked with the plate packs as a welder. After two years, I became Production Foreman. Between 1995 and 2007 I worked as a Maintenance Foreman and Welding Coordinator, and in 2007 I was made a Quality Manager. Since 2009, I've also been responsible for the tasks of Occupational Safety Manager and Environment Manager.

What do you like best about your job?
My work is versatile and varied, and there are plenty of challenges: in improving the quality of the product and operations as well as the safety culture. Environmental issues also require a lot of attention.

Can you describe a typical day at work?
I lead the quality team, which consists of 12 people. They work in different roles from quality and welding engineering to quality controlling and documentation. While the content of my work days varies according to what kind of projects we have going on, a typical day involves problem-solving, meetings and audits, CE certification and maintaining quality guidelines. Even though the work week can be roughly planned ahead, a day seldom goes by without some unexpected issues that might require a quick solution.

What kind of situations bring out your best qualities?
My role is to act as mediator and seek solutions. I believe I'm at my best in situations where my experience is useful and the goal is to find a collective solution to a problem.

What, to you, is Vahterus's most important value?
Constant development and enthusiasm for improvement, which also means investing in employee development. I think these are fundamental factors in building and maintaining a successful company.

What could Vahterus be better at?
We could still improve the quality of the welding, in the sense that it could be more even and have fewer flaws. But all in all, we can be proud of our high-quality product. What needs more attention and involvement is the safety culture. That's something that can't be changed immediately but requires time and focus.

When do you feel you've succeeded in your work?
My work is mostly about focusing on developing things, so the best reward is to see that work actually leading to concrete results, where the quality of the product and the operations has been improved.

What are your ambitions for the future?
I recently attended an occupational safety audit carried out by one of our customers. Among other topics, Vahterus' accident frequency rate came up. It was average within the Finnish metal industry, but rather high in international terms. That was a good reminder that there's still a lot to be done in developing a stronger safety culture.

If you weren't doing this job, what would you be doing?
I'd probably be working in agriculture and forestry.

How do you spend your time outside work?
I enjoy boating in the summer. In winter, I keep myself busy with forestry work. I also like to travel.

In the midst of everyday life, what delights you?
A good and open work environment with room for humour.

What inspires the great team spirit at Vahterus?
The fact that Vahterus is family owned gives it stability and clear values. I believe our team spirit has also been built by simply working and growing together. Many employees have been with us for a long time, and over the years, we've grown from a small family business into a significant international company.

Which new skill would you like to learn?
I have no new skill in mind at the moment. Instead, I look forward to developing and deepening my existing skills.

What do your co-workers not know about you?
This summer, I became a grandpa for the first time.

Who of your co-workers would you like to praise?
I'd like to praise my entire team for their good work, for showing initiative and carrying out their roles with such responsibility.

Vahterus units keep things running smoothly at Pölkky wood processing plants

Ville Kesälä, Key Account Manager at Vahterus

Founded in 1968, Pölkky is the largest privately owned wood-processing company in Northern Finland. The group's sawmills and further processing plants are located in Taivalkoski and Kajaani in the heartland of Finnish raw wood, the municipality of Kuusamo. In 2017, Pölkky produced approximately 650,000 m2 of sawn timber with a group-wide turnover of €168 million. Modern wood-processing techniques and skilled personnel are the foundation of Pölkky's high-quality products and efficient operations. In total, Pölkky Oy employs approximately 200 people. In addition to Pölkky, other companies in the group include Pölkky Metsä Kmo Oy, Kitkawood Oy and Kajaaniwood Oy with a combined staff of about 380.

In spring 2017, staff at Pölkky's Taivalkoski production unit noticed that the tube heat exchanger located between the hot-water boiler and the district heating network needed replacing. Hot boiler water circulated in the exchanger's primary side and district heating water in the secondary side. "The heating plant had a roughly seven-year-old tube heat exchanger that was part of the original installation", explains Pölkky's Plant Service Manager, **Arto Hannola**. "The exchanger didn't run reliably and we had to goggle the tubes every couple of months. We wanted to improve the system's reliability, so we started planning to replace the heat exchanger."

The company contacted Vahterus, and staff members from both companies got together to discuss a tailored solution. The new heat exchanger would operate between the boiler and the supply network, and the aim was to protect the boiler from any supply water leakages and to improve its reliability in the event of a leak. Vahterus started the project by listening to what the client needed and then offered a unique solution designed specifically for this application. While most Vahterus projects start the same way, the cooperation between Vahterus and Pölkky was exceptionally tight.

During the procurement process, Pölkky delegates visited a reference site where the Vahterus unit made a lasting impression on them. Having considered different options together, the companies eventually chose to replace the old tube heat exchanger with a more compact solution, after which a fully welded 12-MW plate heat exchanger was installed in the Taivalkoski production plant. "I had good experiences with a Vahterus exchanger in my previous job, so we started preparing the project based on this", says Hannola. "Eventually we placed the order and had the new exchanger installed, and we haven't had any issues with the equipment since then."

Vahterus Plate & Shell technology is ideal for power plant applications because the fully welded heat exchangers have no soldered joints or gaskets and the round shape allows them to withstand considerable heat stress. These features are crucial for units used in the varying conditions of boiler plants. Moreover, the compact size makes installation in power plants easier.

This autumn, a little over a year since the Taivalkoski

"Vahterus Plate & Shell technology is ideal for power plant applications because the fully welded heat exchangers have no soldered joints or gaskets and the round shape allows them to withstand considerable heat stress. These features are crucial for units used in the varying conditions of boiler plants."

Pölkky replaced an old tube heat exchanger in Taivalkoski production unit with a fully welded 12-MW Vahterus Plate & Shell heat exchanger. The compact size makes it easier to install in a production plant.

upgrade, Pölkky decided to convert the direct connection between the boiler and district heating network in its Kuusamo unit into an indirect connection. The project requirements were the same as those for the Taivalkoski unit. "In its current state, the boiler is directly connected to the district heating network, so by installing a heat exchanger between them, we can protect the boiler from any major leakages, as these could cause major damages to the boiler", clarifies Hannola.

The direct connection was considered a risk since the Kuusamo plant is in operation year round, meaning that even short downtimes lead to production losses. After the positive experiences of the Taivalkoski unit, it was only natural that Pölkky would continue working with Vahterus. The companies therefore got together once again to discuss the best solution, and eventually a 12-MW water-to-water heat exchanger was tailored for the Kuusamo plant. In order to ensure reliable operation, an indirect connection was found to be the only option, even though indirect connections have traditionally resulted in losses. Vahterus plate heat exchanger technology helps keep temperature differences extremely small, which minimises these losses. With the risk of losses eliminated, an indirect connection often turns out to be the best solution to ensure security of supply and efficient operation. This is because disturbances in the district heating network are not directly connected to the boiler, making it more reliable.

Vahterus Plate & Shell heat exchangers have been used to replace numerous old tube heat exchangers and gasket heat exchangers in order to improve a system's reliability and make it easier to maintain. In applications like these, having a maintenance-free solution is a clear competitive advantage. Today, Vahterus heat exchangers can be found in several boiler plants, especially at large industrial sawmills. "The Taivalkoski project was extremely successful, all things considered. The Kuusamo project has progressed to the order stage this autumn, and our plan is to have the new heat exchanger installed around the turn of the year. All in all, working with Vahterus has been a very satisfying experience for us", Hannola concludes.

Accent Refrigeration's three most recent projects have been based on using Vahterus low-charge heat exchangers to improve safety and efficiency.

Improving Safety and Efficiency at Ice Rinks with Accent Refrigeration

Art Sutherland, Founder / President and CEO at Accent Refrigeration

Accent Refrigeration Systems of Victoria, British Columbia (BC), Canada, have been designing and manufacturing ammonia refrigeration systems for 30 years. The two major markets in which Accent specialise are high-efficiency refrigeration systems for the ice-skating industry and energy recovery heat pumps for a myriad of applications. By harvesting the large quantity of low-grade waste heat from community ice rinks to be used as a high-quality energy source on the evaporator side of energy-recovery heat pumps, Accent are able to produce exceptionally high COPs, resulting in very happy customers on both ends of the refrigeration spectrum. One great example of this reliable energy- recovery technology is the Westhills housing development in Langford, BC, where Accent's ammonia heat pumps have been efficiently heating close to 800 homes for almost ten years.

Always on the lookout for ways to lower the refrigerant charge, improve safety, reduce leaks and to improve efficiency, Accent Refrigeration's founder, Art Sutherland, was introduced to Vahterus heat exchangers at the Chilventa trade show in Nuremburg, Germany, eight years ago. The timing of the introduction was perfect in that Accent Refrigeration was in the early stages of designing an ammonia / CO2 ice rink for a project in South Africa and the Vahterus heat exchangers were perfect for this high-pressure application. The ice rink was completed at The Grove Mall in Johannesburg and was the first of its kind in South Africa. The energy efficiency significantly exceeded the other four rinks owned by the same client, which made it easy to choose ammonia / CO2 for their next rink.

Following the success in South Africa, Accent Refrigeration designed the first ammonia / CO2 ice rink in North America, which was installed at the University of Alaska in Anchorage. The design was also based around Vahterus heat exchangers for both the ammonia / CO2 side as well as the condensing side, where up to 100% of the waste energy was used for preheating the large quantities of fresh air in the main campus building.

Since those early ventures into Plate & Shell design, the Vahterus heat exchanger has become a standard at Accent Refrigeration. It has been deployed for a number of new applications that they are undertaking, including converting high-charge direct R-22 systems to low-charge ammonia, as well as high-temperature two-stage ammonia heat pumps for heating public buildings.

Accent's three most recent projects have been based on using Vahterus heat exchanges as chillers that use aqua ammonia as a secondary coolant to reduce secondary pumping horsepower while using Vahterus condensers to recover all of the waste heat.

2017 was a tough year for ammonia refrigeration in Canada: three lives were lost in an ice rink when an antiquated Shell & Tube chiller underwent a catastrophic failure while two operators and a mechanic were in the compressor room. These ammonia fatalities where the first in the ice rink industry, which has enjoyed over 125 years with no loss of life.

Following the incident in Canada, Accent Refrigeration led the way in conducting awareness and safety courses across Canada and the USA, reinforcing all positive attributes of ammonia as a primary refrigerant. A major cornerstone in further improving ice rink safety was introducing facility owners to the benefit of low-charge systems that are made possible with Vahterus heat exchangers. Many of the traditional ice rink systems had ammonia charges in excess of 800 pounds, whereas by combining Plate & Shell chillers and condensers, we are getting the ammonia charge down to less than 50 pounds.

When we can improve safety and efficiency, while having no negative impact on the environment by using Vahterus low-charge heat exchangers, it becomes a winning formula for all stakeholders.

World's Largest Plate & Shell Heat Exchangers for Cooling Installed in a Mine in South Africa

Brandon Loots, Managing Director at Zonke Engineering

More than half of the platinum produced worldwide comes from South Africa, and Impala Platinum is the second largest platinum producer in the world. The company's mines have several mineshafts that have been fitted with 69,000-kW ammonium cooling systems. The oldest cooling unit was installed in 1985, and the newest in 2002.

The mine's primary cooling system is the surface cooling unit, while the secondary system involves channelling cooled service water underground. The water required by the secondary system is usually cooled during the night when the air temperature is lower and the surface cooling system is operating with a lower cooling capacity.

The surface cooling unit is a two-chamber direct-acting counterflow cooling tower equipped with drift eliminators. The system's design flow rate is 432 litres per second. The cooled water supplied by the coolers is sprayed downwards. The water is collected in a pool from where it is pumped into water coolers and back to the surface cooling unit in a closed system.

The surface cooling unit is designed to process airflows of 400 kgs with the help of four centrifugal blowers, when the temperature of outgoing air is 7.2 °C. The surface cooling unit's nominal cooling capacity is 15,100 kW, which can be achieved when the maximum temperature of the incoming water is 3.6 °C.

The process water is transferred to a 2,000-m^2 underground cold storage unit with the aid of gravity. The water flow rate is approximately 70 litres per second.

The system also has a pre-cooling tower with a nominal cooling capacity of 4000 kW. This cooling tower lowers the temperature of the water coming back from underground as much as possible before the water goes to the water coolers. The approach temperature of the cooling tower water is approximately 2 °C.

The system is cooled by two ammonium-based Howden coolers installed side by side. The compressors are WRV-510/165-type screw compressors, both of which are powered by their own 1850 kW engines. The units are designed for a fixed volume ratio of 2.1. The older unit has a regular oil cooling system, while the newer unit has a liquid jet oil cooling system. These large screw compressors were specifically designed for the South African mining industry in the 1980s.

The nominal cooling capacity of both water coolers is approximately 8,300 kW when measured according to the evaporation temperature of -1 °C and the condensation temperature of 32 °C. The compressor engines are designed to be slightly too powerful due to the unusual operating environment. The design temperature of cooled water is 1.5 °C.

The older units require basic maintenance due to their age. In 2006, the company decided to replace all plate evaporators installed in the 1980s equipment due to signs of malfunctioning and the risk of ammonia leaks. However, replacing the evaporators, which were fitted with titanium plates, would have been an expensive process because titanium prices rose sharply in 2006 and 2007 and the delivery times were long. Titanium plates were used in the evaporators because water used in mines is often of poor quality. The evaporators are flooded evaporators, which are based on the principle of natural convection and counter-flow operation in the flow of water and liquid ammonia. Due to this, Impala Platinum decided to alter the cooling system of these mineshafts, so that cooled water would no longer be circulated underground and so that the closed circulation system would only be needed to circulate cooled water into the overground surface coolers. This modification would make it possible to replace the

Impala Platinum mining operations located on the Bushveld Complex in South Africa.

circulating mine water with potable water, meaning that there would be no need to continue using titanium plates.

Zonke Engineering contacted Impala Platinum and Hatch and suggested using Vahterus Plate & Shell heat exchangers in the updated system. Both Impala Platinum and Hatch were interested in the concept, but were suspicious of using 'new' technology in such a large application.

When the decision to replace the old plate coolers of the ammonia cooling units had been made, the team started to work on the selection criteria of the new heat exchangers. The new units needed to have:

– the same heat exchange capacity as the old units
– a robust structure
– ease of maintenance
– solutions that reduce the risk of ammonia leaks
– the option of using pre-existing cooling water pumps (the units' differential pressure had to be lower than or equal to the differential pressure of the old system)
– a structure that would require as few changes to the original cooling system as possible, including piping and control devices
– a 'universal' structure compatible with the thermal and technical characteristics of the previously installed ammonia evaporators.

The Shell & Tube heat exchangers were excluded from the list of potential replacements due to the amount of space they need, meaning that the final list of candidates was fairly short. The last question was whether the oldest plate heat exchangers would be replaced with new similar exchangers or Plate & Shell heat exchangers. Plate & Shell heat exchangers had never before been used in a cooling application of a similar capacity or size. After careful consideration and detailed discussions with Zonke Engineering and Vahterus about potential risks, Impala Platinum and the consulting firm Hatch decided to buy Plate & Shell heat exchangers.

The system to be replaced first was the cooling system of mineshaft no 1. This system consists of two parallel ammonia cooling units with a nominal cooling capacity of 8,300 kW. The first component to be replaced was the evaporator in the oldest machine.

The cooling system of mineshaft no 1 had several unique features, including:

– Possible change in the circulation ratio of the ammonia circulated via an evaporator due to the circulation system of the coolant, which is based on the principle of natural convection
– Changes in water districts
– The flow rate of each cooling unit, which is half of the total flow rate of two parallel-installed cooling units, or the total flow rate when only one unit is in use. This has an impact on pressure losses and the working point of the cooling water pumps.

At first, the team decided on a size 14 Plate & Shell heat exchanger, or the largest currently manufactured heat exchanger. Due to space and weight limits, however, the team eventually selected two shorter units of the same model. The benefit of using two units is that if ammonia leaks from one of the units and reaches the water, the unit in question could be isolated from circulation and the cooling unit could run on a partial load with the help of the remaining heat exchanger.

Another benefit of the new heat exchangers was the fact that the location of the surge drum could be changed, unlike in the old units. The plate heat exchangers had an ammonia circulation ratio of 1.5. The pressure loss of the new heat exchangers was lower, which increased the coolant circulation ratio to four and above. The circulation ratio is the ratio between the total amount of a heat exchanger's incoming coolant and the amount of evaporated coolant.

A problem that the team encountered when replacing the old heat exchanger was the fact that the plate stack of one of the exchangers did not pass the nitrogen pressure test performed on site. The faulty unit needed to be opened and the plate stack replaced with a backup stack supplied with the primary units. The plate stack was believed to have been damaged during sea transport.

Measuring the performance of the new units was of utmost importance. To run the tests, the team needed to carry out the following measures:

– Performance approval tests, which needed to be performed within 30 days of installation, when the units were still clean
– Re-calibrations and checks of all components
– Tests to confirm that the amount of oil transferred from the oil separator remained within the permissible limits
– Tests to ensure all changes made to the control devices had been made and installed correctly.
– The tests needed to be performed with both cooling units running in parallel (meaning that half of the flow rate went through one unit) and with the water flowing through one unit only.
– The test could only be passed if differences in the energy levels stayed within a 5% margin of the defined values.

Table 1 shows the results of the tests where the two units were running in parallel.

The tests revealed that pressure losses on the water side were considerably larger than originally estimated, but still clearly smaller than the pressure losses of the original plate heat exchanger at the same flow rate.

It must be noted that even though design values could not quite be achieved due to the conditions at the time of the tests, the team did achieve the desired total heat transfer coefficient.

The approach temperature observed during the test was better than the planned temperature because there was less cooling capacity available during the test.

Plate & Shell heat exchangers have proved to be an excellent and safe choice for flooded evaporator applications requiring a large cooling capacity. Thanks to the lower pressure loss of Plate & Shell heat exchangers, the pump mechanism requires less electricity.

Moreover, the Plate & Shell heat exchangers also benefit from gaskets that do not need to be replaced at all, unlike plate heat exchanger gaskets. This helps bring maintenance costs down and considerably reduces the risk of ammonia leaks.

Due to the success of the installation project, Impala Platinum has launched a project to replace the plate heat exchangers in all mineshafts with Vahterus heat exchangers. As Andre Pieters, mechanical engineer at Impala Platinum commented:

"The use of PSHEs for underground cooling of the mine shafts at Impala Rustenburg mine has proven itself to be the right long-term choice. The benefits over the original Plate & Frame heat exchangers used in this application have been immense. These include almost total elimination of the maintenance that was required in terms of replacing gaskets and damaged plates of the old Plate & Frame heat exchangers. Also, the integrity of the Vahterus units has made a huge difference to ensuring a reliable and safe operation with no risk of ammonia leakage and the possible effects of this getting into the chilled air that goes underground."

Table 1: Summary of tests performed with both cooling units running in parallel

DESCRIPTION	UNITS	SPEC. VALUE	TEST VALUE
Surge drum suction pressure control	kPa		320
Equivalent surge drum ammonia temperature	°C		-1.23
Ammonia temperature at inlet ports	°C	-1.3	-0.94
Total combined evaporators' flow (No. 1A + No. 1B)	L/s	238	290
Evaporators' water inlet temperature	°C	10.0	7.8
Evaporator No. 1B water outlet temperature	°C	1.0	1.23
Evaporator No. 1A water outlet temperature	°C	1.0	0.87
Average evaporators' water outlet temperature (No. 1A / No. 1B)	°C	1.0	1.05
Temperature approach	°C	2.3	2.0
Compressor loading	%		100
Total combined evaporators' duty (No. 1A + No. 1B)	kW(R)	9037	8196
Uncorrected logarithmic LMTD	°C	5.377	4.487
Overall heat transfer coefficient (clean)	W/m2 K	1721.7	1725.0

E.ON installation of four GEA heat pumps next to the sewage treatment and waste incinerator plant in Malmö, Sweden. The heat-pump system draws nearly 30 MW of heat from the sewage water Malmö's harbour area.

40 MW Ammonia Heat Pumps are Revolutionising District Heating in Sweden

Kenneth Hoffmann, Product Manager / Heatpumps at GEA

E.ON, one of the world's largest investor-owned electric utility service providers, installed four GEA heat pumps, each with a heating capacity of 10 MW (1 MW = approx. 2,500 homes) next to the sewage treatment and waste incinerator plant in Malmö's harbour area. The heat-pump system draws nearly 30 MW of heat from the sewage water. Previously sent directly to the sea as waste heat, the energy is now harvested from the clean wastewater before it is returned to the sea. On average, the wastewater is chilled from 14 °C to 8 °C and the energy harvested is used to fuel the district's heating network through the heat pumps. 40 MW of heat is being returned every second to the district heating network at around 66 °C, providing heat for a total of 10,000 homes.

Energy harvesting

By harvesting the heat from the wastewater, which has a constant high temperature, the plant is running with greater efficiency than if it had been using seawater (-15% efficiency) or ground source water (-10% efficiency).

In the winter, the seawater around Malmö gets close to 0 °C and requires frost protection and a higher temperature lift from the heat pumps. Since there can be some organic material in the wastewater, the Shell & Tube evaporators have been fitted with a ball cleaning system that continuously cleans the stainless-steel tubes to avoid fouling in the heat exchanger and maintain high efficiency without having to stop the heat pump.

District heating network

The heat pump has been integrated into the district heating network to work together with the nearby waste incinerator plant. The water from the city returns to the waste incinerator plant at around 50 °C, whose flue gas economiser is heated to around 55 °C before going into the heat pump, where it is heated to 66 °C. The water then returns to the waste incinerator plant, where it is heated to the temperature required by the heating network, which can vary from 70 °C to 90 °C. The heat pump is designed for delivering heat up to 80 °C, but will rarely deliver above 71 °C.

Refrigerants

To maximise efficiency, ammonia has been chosen as the refrigerant in the heat pumps. This natural refrigerant has a GWP of 0. The plant's life expectancy is 20–30 years, so it is important to choose a refrigerant that will be available throughout this time span. Many new synthetic refrigerants are being introduced onto the market under the common group name HFO, but as is the case with all the synthetic refrigerants before them, their long-term impact on the environment is unknown and they are likely to be phased out of the market in time. The new refrigerants have also proved to be very expensive: in this case the refrigerant charge would have cost close to £1M, while the ammonia charge cost £20,000.

Economic benefits

The four heat pumps operate in parallel, each with a coefficient of performance (COP) above 3.50, so that each 1 kWh of electricity used by the pump produces 3.5 kWh heat for the city. The pumps will all run at 100% from October to April. In the summer months, there is sufficient heat from other renewable sources to feed into the heating network. Only at peak times in the summer months will one or two of the heat pumps be running. The pumps will deliver 200 GWh per year – 8% of Malmö's heating demand. This will save 50,000 tons of CO2 emission, the equivalent of taking 10,000 petrol cars off the roads.


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