

VAHTERUS

**Vahterus Gets a
New Visual Identity**

**Building a brand language to
communicate our core values**

**Vahterus Delivers heat exchangers
to the Largest Refined Product
Pipeline System in the US**

HOT & COLD

No. 1 2018

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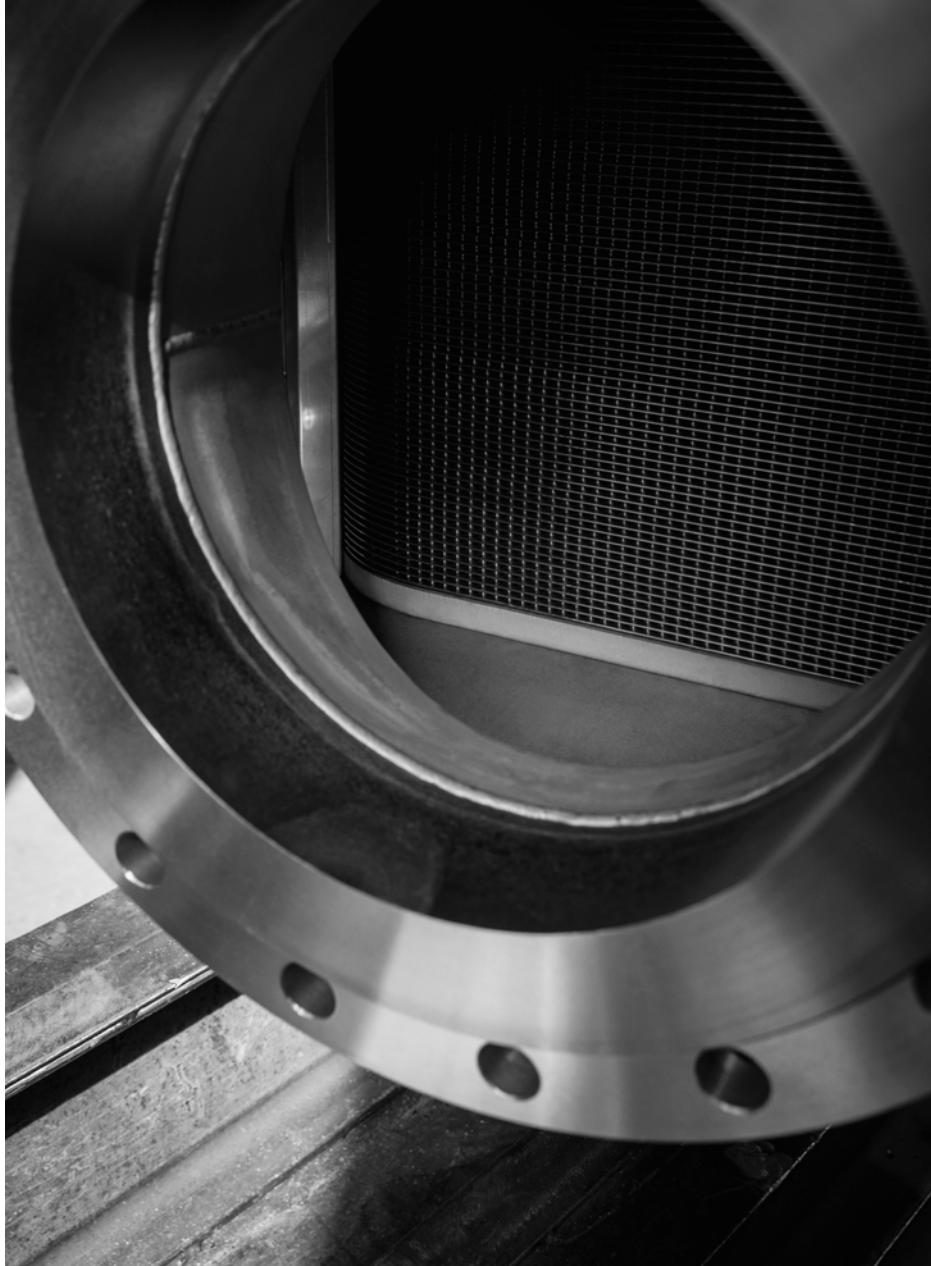
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ON THE COVER

Front: Our plate pack
photographed at Vahterus
manufacturing facilities in
Kalanti, Finland.

Back: Welder Cai Guo Dong
measuring a unit under
production in Vahterus assembly
plant in Zhangjiagang, China.

Photography by
Anton Sucksdorff

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Dear Partners, We Continue to Build New

Looking back at 2017

There was – and still is – a great positivity in the market sectors in which Vahterus operates globally. Our turnover grew by 11% compared to last year. The markets were particularly favourable in industrial refrigeration and LNG applications.

Thank you for making our collaboration successful. I would also like to extend special thanks to our entire staff, who made all of this possible, as well as showing extraordinary flexibility when our production load was at its peak at the end of last year. This is how we were able to ensure a high level of delivery reliability for our customers.

We also achieved a new annual record in the number of Plate & Shell heat exchangers manufactured. In total, over 50,000 are in use around the world. We have a good basis on which to build for 2018, not to mention our continuing strong will to grow. In terms of sales, the start of this year seems very promising.

Investments for 2018

Our focus points are broadening sales channels, digitality with several development projects, R&D and machine technology. We're also expanding our production facilities by 1,300 m². In keeping with Vahterus tradition, the extension has been named after a Kalanti village, and will be called Petes Halli. This is our seventh expansion project in 27 years. With its completion, our total floor space will be 1.3 ha, much larger than the 0.3 ha we had in the early days of the business.

I strongly believe that by continuing to invest in our business, we'll remain a competitive player in the growing heat-exchanger market.

New visual identity

Vahterus's visual identity has been built up over the last 27 years. Now it's time for something new, and our aim is to ensure that the results of this renewal are visible in all we do and all we are. This magazine is a fine example of that.

Our logo has been improved, our brand colour scheme clarified, and our website and all our publications are getting a new look. Our new visual identity is introduced at Achema 2018 exhibition (11–15 June). I'm keen to hear your feedback and views.

Particular thanks for achieving this renewal go to our 'youth chain' consultants: **Hennamari Asunta, Hanna Kontu, Anton Sucksdorff, Linda Bergroth** and our marketing team **Sari Kesälä and Katri Isotahdon** for their eye-opening, fresh perspectives and implementation efforts. Excellent work – simple, effective and beautiful. I hope you'll feel the same.

Achema 2018

The flagship exhibition for the chemical industry is Achema in Frankfurt. In addition to our new visual identity, we'll also show new products that I have no doubt will help make your processes even more efficient, whilst also protecting nature and the environment. One of my great desires is to build a world fit for generations to come – a desire I'm sure we all share.

Together we succeed!

Mauri Kontu
CEO, Vahterus Oy



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



Shell side view of new 5SH plate pack. Instead of the round shape of the original plate, the new plates use the shape of an athletics field.

Research & Development

Slimmer Sibling for Vahterus Plate Family

Valtteri Haavisto, Customer Service Director at Vahterus

The family of Vahterus heat transfer plates continues to grow with a new plate. The slimmer plates, launched in mid-2018, use the shape of an athletics field, combined with the same optimal corrugation options as the Vahterus round plates. Plate configurations are designated SH or SL depending on the corrugation angle, where S

stands for 'slim', and H or L for 'high' or 'low' heat transfer plate corrugation options. This new plate type is designed for application in gas heating and cooling, but alternative uses are certainly possible in the future. The Vahterus slim plate has a longer flow path on the plate side and a shorter flow path on the shell side, which leads to a low-pressure

drop on the gas side, and optimal heat transfer and performance on the plate/liquid side. The default design utilises cross-flow configuration, maintaining the equivalent shell designs used with traditional PSHEs.

The tests made by Vahterus's R&D have proved that the slim plate provides an effective heat-transfer solution in gas cooling and heating applications, whilst at the same time maintaining low gas side pressure drop. Vahterus is confident that this will provide a very effective heat transfer solution in gas-based applications, notably for

heat-recovery cases. In this first stage of development, the new plate series will have a design pressure range of 6–60bar(g) (depending the plate size), relevant to the design temperatures typical of such applications. Thermal design tools, as well as all manufacturing capabilities, are ready to go for the new heat-exchanger type. In the initial stages, plate sizes 3 and 5 will be available, first deliveries taking place later this year. The Vahterus Sales Team is happy to tell you more about these new developments, and how they can optimise your processes.

Testing with HTRI in Navasota, Texas

Thomas Lestina, Senior Vice President Engineering at Heat Transfer Research

As Plate & Shell Heat Exchangers gain acceptance in the process industry, many potential users are seeking validated performance data of the latest commercial plate technology so that they can be assured of adequate operation. HTRI, a leading source of process heat-transfer technology, is working with Vahterus to assess the PSHE performance for liquid-liquid and boiling service.

Vahterus shipped two test exchangers to HTRI's multimillion-dollar Research & Technology Center (RTC) in Navasota, Texas, USA. HTRI installed one in the Liquid-Liquid Heat Exchanger Test Unit for water-water tests and the other in the Prototype Test Unit for boiling tests with pure hydrocarbons and hydrocarbon mixtures.

From the water-water test results, HTRI developed and validated a heat transfer and pressure drop model for single-phase service. The boiling tests allowed to study the impact of nucleate and convective boiling mechanisms, and to investigate corrections needed for mixtures.

The HTRI testing demonstrates that the PSHE is a compelling alternative, not only to Shell & Tube exchangers but also to other plate technologies such as gasketed Plate & Frame exchangers and welded rectangular plate exchangers. The test results are documented in two re-

ports soon released to HTRI members. Working closely with Vahterus, HTRI is continuing its analysis of the test units with the development of a CFD model of the corrugated plate surfaces. The high-fidelity model provides insight into factors that affect flow distribution and pressure drop, leading to improvements in overall performance.



HTRI Research & Technology Center in Navasota, Texas

We Have a New Look

Our new visual identity is built on the core idea and values of our company. With a new logo, color scheme, fonts and images, the brand message of Vahterus is clear and confident.

Hanna Kontu, Head of Identity Remake Concept, Board Member at Vahterus

Vahterus's visual identity has been built up over the last 27 years. During that time, our company has grown significantly. We've invented new technologies and supplied premium heat exchanger solutions to customers all over the world. This spring, we decided it was time our visual identity reflected the creativity and confidence achieved by our products and business.

The magazine you're reading is one example of our new visual identity in action. The colours, typography and new brand imagery all follow our updated guidelines.

Visual identity can easily be dismissed as just a 'look'. However, a meaningful and consistent visual identity is an essential tool in creating and maintaining a brand. It's a means of direct communication, though often non-verbal.

It's no coincidence that almost everyone in the Western world knows that the colour of Coca-Cola's branding is red and could draw a sketch of the Nike logo. Without even thinking about it, we associate an established company with its chosen visual language. The clearer the message, the stronger the effect.

While our day-to-day work and the quality of our products communicate the core idea of Vahterus in a very concrete way, the purpose of our visual identity is to support and strengthen that message.

What is it that we want to communicate?

The starting point for the visual identity remake was recalling and focusing on all those qualities on which Vahter-

rus is built. Qualities such as our Finnish roots, simple and meaningful design, caring for the environment, reliability, trustworthiness, innovation and customer focus have always been fundamental to the way we think and act as a company, and the products we create together.

To communicate these qualities, we've updated our logo with a design that's strong, clean and dynamic. Our new fonts emphasise the straightforward solidity of our products, and our colour palette has been simplified and made bolder to communicate our core values. Finally, we've built a distinct brand imagery to showcase our product, people and business. Our new look can be found across all our touchpoints from website to exhibition booth and workwear to business cards.

We made it together

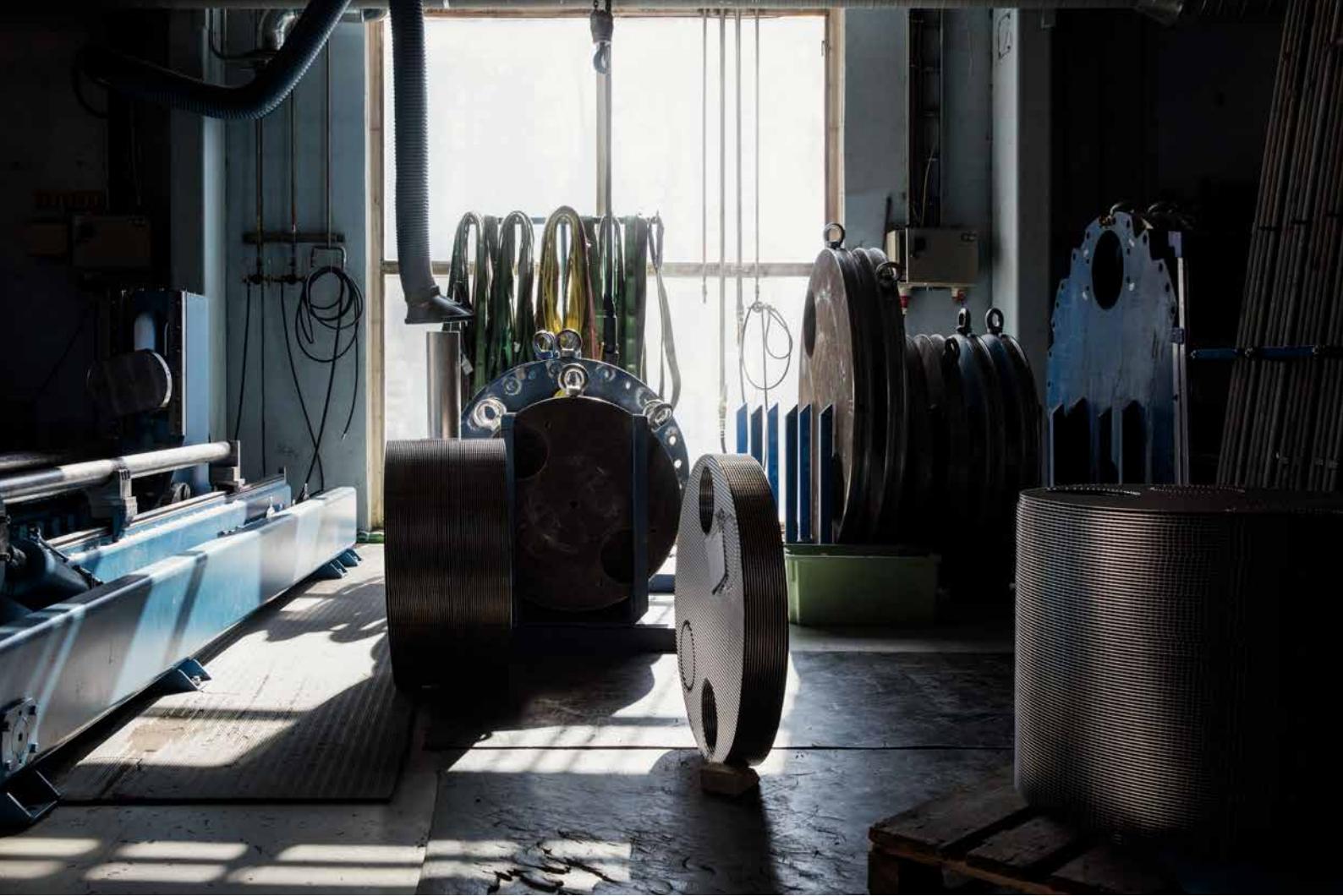
There are a number of people without whom the project wouldn't have taken shape. In particular, I'd like to thank art director **Hennamari Asunta** and photographer **Anton Sucksdorff** for their enthusiasm and dedication to the project. I owe special thanks to writer **Sara Karlsson** for refining our brand voice, and designer **Linda Bergroth** for creating the unique concept for Achema 2018 exhibition, where we launched our new look.

I warmly thank Vahterus's in-house team **Sari Kesälä** and **Katri Isotahdon** for a rewarding collaboration, and all the staff for their openness and help in making this change happen. I hope you enjoy it!

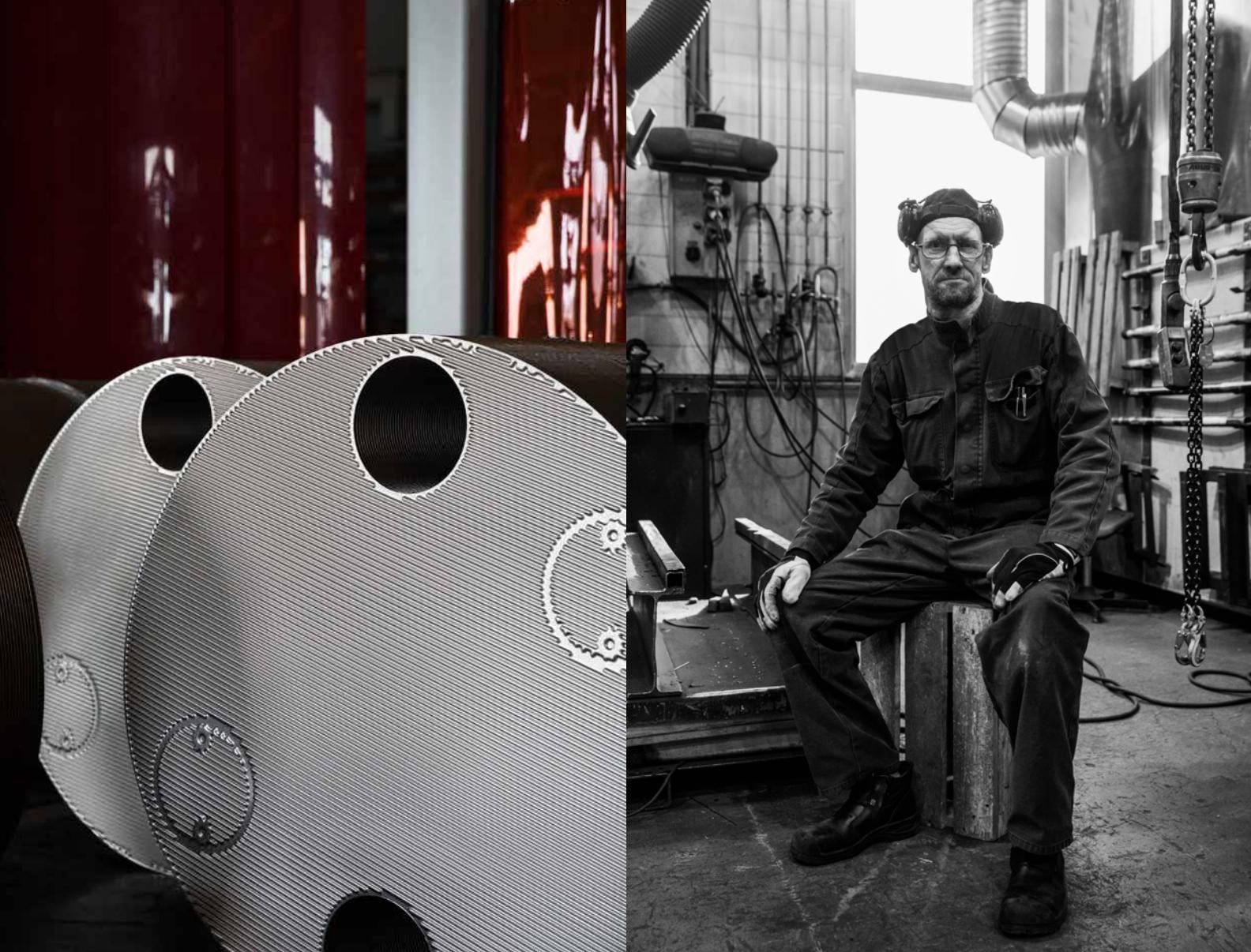
VAHTERUS



Our new look can
be found across
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and workwear to
business cards.



Behind the scenes images communicate transparency while documenting our work environment in a creative and interesting way.

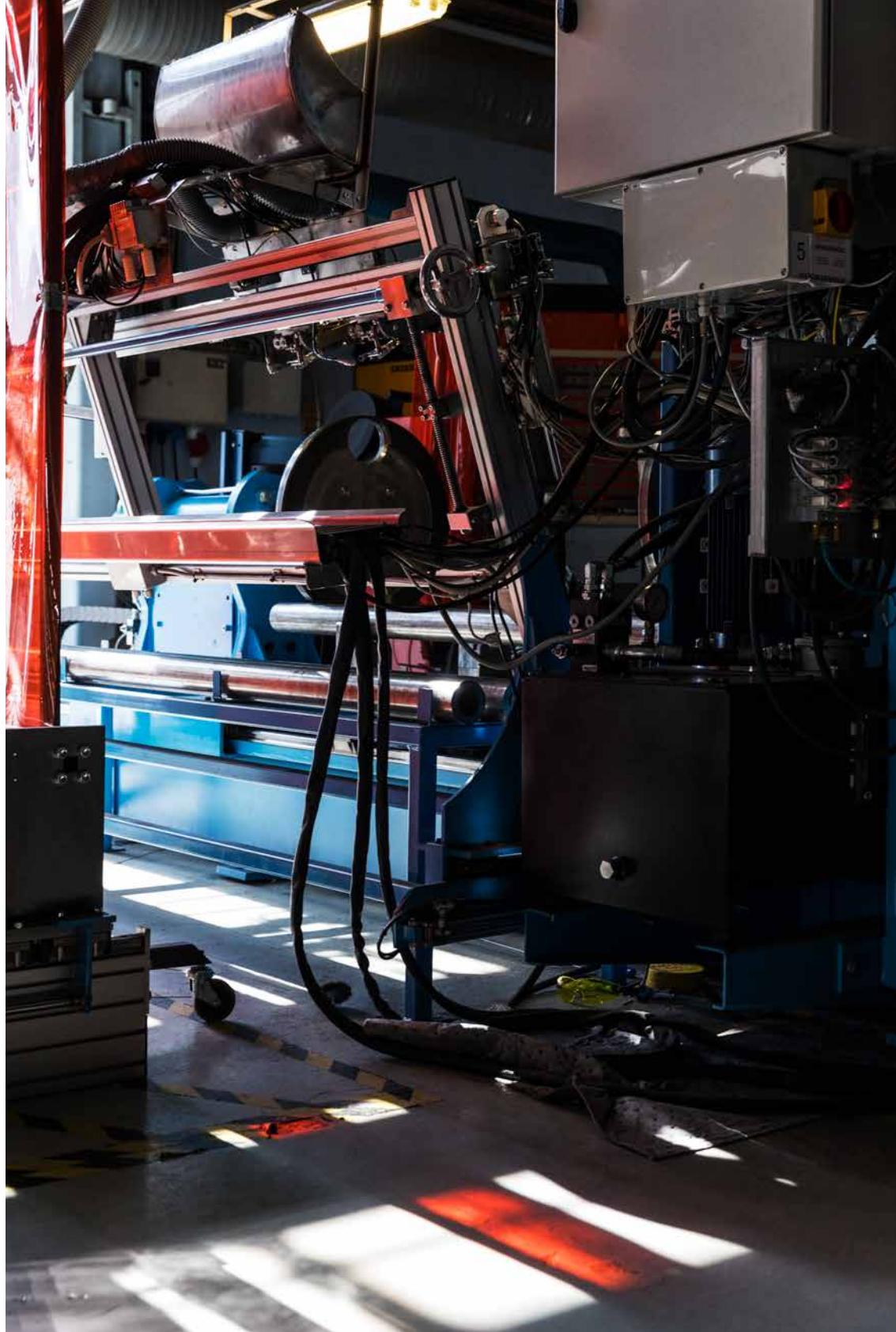


Based on who we are, and what we do, our new visual identity speaks about our values and work spirit as a company.

Product is at the heart of our brand communication. Here, the industrial background highlights its clean design.



Distinct brand imagery
communicates our
pioneering mindset and
distinguishes us from
our competitors. The
new images were taken
by photographer Anton
Sucksdorff.



Meet Our Partner

Export Credit Agency Finnvera Helps Vahterus Secure Customer Financing

Did you know that, with the help of the right financing options, an export business can offer buyers credit at competitive rates? These options include bills of exchange and deferred letters of credit.

Erno Ihto, Senior Advisor at Finnvera

Finnvera is a specialist financing company owned by the State of Finland and the official Export Credit Agency of Finland. One of Finnvera's main goals is to improve the competitiveness of Finnish small and medium-sized export enterprises. Guarantees granted by Finnvera usually help a foreign buyer get financing with a longer repayment horizon and, in some cases, at better rates than those offered in the local private sector. This year, one of Finnvera's main focus areas is to provide guidance on financial and risk management of export business for SMEs.

In the European Union and elsewhere in the West, a bill of exchange can be used as a payment method in customer financing. When it comes to large deals, an example of the sort of payment terms that Vahterus can agree with the distributor might be 30% of the purchase price to be paid upon placing the order, and 70% covered by two bills of exchange falling due 180 and 360 days after the delivery. Payment terms like these can be crucial in a situation where the distributor will not be paid by the end user until later, meaning that they need a longer payment term for an individual Vahterus delivery.

The bank that buys and discounts a bill of exchange can transfer the associated credit risks to Finnvera. Finnvera conducts a risk analysis of every project using information such as the buyer's credit and financial statement

data. Depending on the risks involved in the project, Finnvera can even guarantee a bill of exchange without the buyer supplying a guarantee of their own. In addition to the above, Finnvera also verifies that the bill of exchange is a valid payment instrument in the country of sale, and that the country to which the product is delivered is credit-worthy. A Finnish export company applies for the guarantee for a bill of exchange. When applying for a guarantee, Vahterus must provide information about the buyer, the export deal and financing, and must answer questions about bribery and environmental assessment.

In the emerging markets of Asia, Middle East and Africa, a letter of credit is a common payment method. A confirmed letter of credit is a useful instrument for small or medium-sized export businesses because, in addition to an undertaking being made by the buyer's bank, the exporter's bank also undertakes to pay the exporter if the terms of the letter of credit are fulfilled.

A letter of credit can also be used to grant the buyer more time for payment. If necessary, the confirming bank can share the credit risks associated with the country of export and the issuing bank together with Finnvera. A guarantee granted by Finnvera may allow a longer payment time for the letter of credit. The confirming bank applies to Finnvera for a letter of credit guarantee.

The Best Reward Is Seeing Everything Fall into Place

Like a multitalented master of ceremonies who makes sure that customers get the exact products they need, the project manager must be able hold all the strings and know when to pull the right ones.

"No two projects are ever the same because customer requirements vary. The challenge of the job is to produce a product that's perfect for its purpose", says **Anna-Leena Huhta-Aho**. Huhta-aho graduated from the Tampere University of Technology and has worked as a project manager at Vahterus for 11 years.

It was the challenging nature of thermal technology that made her choose it as her major. "I'm still learning something new every day, even after so many years in the industry", she explains.

Orders that include special requirements are managed as projects. In these cases, the project manager is the 'master of ceremonies' from order to delivery: he or she is the single point of contact for the customer and the go-between for the production and design teams.

"There are all kinds of codes and standards to consider. Especially in the marine sector, there are several classification societies, and mergers between them have become more common. There are more and more special materials, and delivery times are increasingly short", says Huhta-aho when asked about the aspects that make her job interesting. The work is structured but hectic. While talking with Huhta-Aho, it seems that project managers are always in a hurry.

Project manager **Harri Salminen** only joined Vahterus a year ago, but he has an extensive career in thermal technology. He studied to be a mechanical engineer, and his first job was at the Uusikaupunki shipyard run by Rauama-Repola. The shipyard's thermal technology depart-

ment was also where the Vahterus CEO **Mauri Kontu** was working at the time. The shipyard gave a good insight into pressure equipment. As well as heat exchangers, they manufactured boilers for marine and on-land applications. "All my career, I've worked with pressure equipment, either in design or project management roles. At Vahterus, the new element for me is the international connections. That's what keeps me learning every day", says Salminen.

Extreme conditions and strict requirements

Vahterus delivers technologies for demanding conditions. This means that project managers have numerous things to consider: quality requirements, standards and testing. Sometimes projects can be very large in scale and it takes many steps before getting to the finishing line.

"There can be some major changes in the middle of a project. That's when you need to be able to communicate with the design team, the customer and even sales in order to find a solution to every problem", explains Huhta-aho. She is very proud of one particular project where Vahterus supplied a technological solution to the mines of the world's leading platinum producer in South Africa. Heat exchangers were installed in eight mineshafts over one kilometre underground.

The best reward for hard work is to see how everything comes together at the end of a demanding project: the factory, plant or other site is working as it should and Vahterus technology is making it happen.



Harri Salminen (left) and Anna-Leena Huhta-Aho work as project managers at Vahterus in Kalanti, Finland.

Top Quality For Demanding Conditions

The welded plate pack is the core of the Vahterus heat exchanger. The welding is of the highest quality, ensuring maximum durability.

Without a plate pack, you wouldn't have a heat exchanger, only a pressure vessel. Vahterus heat exchangers have no gaskets because their structure is completely welded. In order for the heat exchanger to work as planned, the welding must be of the highest quality. Vahterus's welding engineer **Tuomas Hokkanen** and quality engineer **Lassi Forsström** explain that the key to ensuring this is continuous improvement of methods and strict quality control.

"As new materials arrive all the time we need to develop our welding methods. Today, we're welding titanium, pure nickel, nickel alloy and super austenitic steels in addition to 316L type stainless steel", says Hokkanen.

The material used for a plate pack depends on the medium used in the heat exchanger. "For example, a refinery or ship can use sea water for cooling, which most materials cannot cope with. Process conditions can also change during the life cycle of a heat exchanger. The level of corrosiveness can suddenly become higher than originally planned for. We always try to find a solution for even the most demanding applications", says Forsström.

The materials play a key role in dictating the properties of the heat exchanger, such as its resistance to corrosion. These properties must not be weakened by the welding. "The welding must be as good as the original material. This is the standard you must meet", explains Hokkanen.

Demanding Testing Guarantees High Quality

Quality testing is applied to the entire manufacturing process of the product. First at the inspection line are the plate materials. Their chemical consistency can be determined by positive material identification (PMI) testing.

When the plates are manufactured, measurement inspections and penetrant testing (PT) focus on key properties such as strength. Plates that are found faultless are welded into a plate pack, which is then inspected further in multiple ways.

"We start off by carrying out a visual inspection to see if there are any issues with the welding. Our customers may have more specific requirements, such as performing penetrant testing on all welds. The next stage is leak testing, where a plate pack filled with a mixture of helium and air is submerged into a pool of water. Bubbles will reveal any possible leaks", explains Hokkanen. Each completed heat exchanger will undergo pressure testing required by the relevant code and, when requested by the customer, a helium vacuum leak test.

Vahterus runs its own metal laboratory, which means that it is able to carry out various metallurgical inspections. "They can prepare a macro specimen from the cross-section of the weld and perform macro examination. This way, we're able to regularly check that our welding instructions and their parameters are correct and we can produce even quality."

In addition to testing finished heat exchangers, Vahterus regularly carries out destructive testing (DT) within its internal quality control. The actual pressure resistance of a plate pack can be determined when pressure is added incrementally – until the plate pack explodes.

Forsström believes that their uncompromising work to ensure the highest quality has paid off. "Vahterus' reputation as an expert in demanding conditions is strong. We have numerous regular customers who trust our quality standards."



Vahterus's welding engineer Tuomas Hokkanen (left) and quality engineer Lassi Forsström believe that their uncompromising work has paid off.

Industry Insights

Sustainability Leads Changes in the Market

Refrigeration

Heikki Oksanen, Business Manager at Vahterus

In 2017 Finnish president Sauli Niinistö met within a short space of time the heads of state of Russia, China and the USA. Climate change and its consequences were a topic of conversation at all of these meetings; no one knows in any detail what the future holds.

When a hole in the ozone layer was discovered, a hunt for the reasons behind it immediately began, and it was revealed that refrigerants with high ODPS were one of the causes. Following the 1987 Montreal Protocol, their usage and availability has been restricted, and now in most countries they have been replaced by more environmentally friendly substances. There are now reports that the hole in the ozone layer above the North Pole is shrinking. In the refrigeration industry, we have seen success in the development of new solutions.

When making decisions about new refrigerants, there are a number of factors to consider in addition to how environmentally friendly they are, including long-term usage experiences and efficiency. It is important to ensure availability over a long period of time, as well as in different parts of the world, while the solutions must also be politically viable.

Natural refrigerants are the clear choice, with over 100 years of usage behind them. However, new solutions are also needed, such as ways to run plants on small amounts of refrigerants. This will certainly be a key focus area at the Chillventa 2018 international exhibition. The efficiency of plants in all usage conditions is an area that undoubtedly requires more attention. Energy recovery must be increased and new ideas and technologies are needed.

Energy

Tobias Hägglom, Business Manager at Vahterus

The outlook for the energy industry appears brighter now than it has looked for a long time. Although investment levels are somewhat lower than when oil prices were around \$100 per barrel, many projects are becoming viable with prices climbing to over \$60 per barrel.

According to recent figures by Global Data, almost \$800bn will be spent on over 600 upcoming oil and gas fields globally between 2018 and 2025. Brazil, Russia and the United States will each account for around 10% of the total capex spend. Brazil will have the biggest share,

followed by Russia and the United States. In both Brazil and the United States, the largest part of the investment will be in Ultra-Deepwater projects, whilst in Russia the investments will be primarily onshore.

The following three countries, in terms of investment expenditure, are Nigeria, Australia and Mozambique. In all these countries – except Russia, where the main investments will be in either Deepwater or Ultra-Deepwater projects – this involves floating production platforms, where compact heat exchanger technologies are a great advantage. This marks a significant opportunity for us at Vahterus.

The Floating Liquefied Natural Gas (FLNG) market is expected to grow around 25% yearly, and reach \$90bn by 2024, according to Energias. The fastest growing area is for the small and mid-size FLNGs. Again, compact design features are at a premium here. In addition, the FSRU

(Floating Storage Re-gasification Unit) market is expected to grow 20% yearly up to 2024.

Heat and power investments in Europe continue to suffer from low power prices. However, considerable environmental drivers such as the shut-down of nuclear power plants in Germany and Japan will increase the investment rate.

The global power production by biomass is currently below 500 TWh, but is expected to reach over 900 TWh by 2022. This is a great opportunity for Vahterus, with the first Plate & Shell deliveries to this industry dating back to the early 1990s.

From Vahterus's point of view, 2018 has started well in the energy sector, where we are experiencing significant growth compared to last year. With the correct focus and a little help from the global trends outlined here, we are likely to have a successful year.

Chemical and Process

Marko Rantala, Sales Director at Vahterus

Vahterus Plate & Shell heat exchangers serve a wide range of applications in the chemical and process industries, and Vahterus has been following trends in these fields with new applications and processes. The case stories presented in this magazine give an overview of what has recently been implemented.

The article by INERATEC, for example, illustrates the application of the smallest heat exchangers in the Vahterus range: a unit operating in the process of converting biogas to liquids. The Colonial Pipeline gasoline coolers, on the other hand, are a great example of larger Plate & Shell exchangers – certainly in terms of equipment weight.

Bio-based feedstock is being utilised more often as the raw material for chemical processing. Also recycled feedstock, like plastic bottles, can be turned into diesel or non-recyclable garbage into cellulosic ethanol, bio-methanol and renewable chemicals. These processes produce relatively small quantities compared to traditional

oil-based processing, but more and more of these projects are coming on line as the industry changes, and the Vahterus Plate & Shell offers a great solution.

In addition to being able to make use of waste heat from chemical processes through heat recovery, we have recently seen installations involving cold energy recovery. When re-gasifying liquefied gases, such as ethane or LNG, cold energy can be recovered for cooling purposes outside the chemical complex or the LNG terminal.

Vahterus solutions with intermediate refrigerant circuits have been installed for many years in gas carriers, but now we also have installations at onshore installations in an LNG terminal in Spain and an EO plant in China.

One of the biggest events this year is the leading process industry exhibition Achema 2018, where we showcase our latest innovations, including the first prototype of our mobile application, as a part of Vahterus's solutions for industry 4.0.



Tracy Hakala photographed at Vahterus Head Office in Kalanti, Finland in April 2018.

Meet Our Team

Developing Business and People with a Desire to Grow

Tracy Hakala is our Managing Director for China, Australia and New Zealand. Living and working in different countries and environments has made her an expert on cross-cultural communication.

What is your work history with Vahterus?

I have been working here since February 2011. I established our China operations, first Vahterus Shanghai for trading business in 2011, followed by Vahterus Zhangjiagang, the assembly plant, in 2012. In August 2015, I moved to Australia with my family, and became our local contact for the Australian and New Zealand markets.

What do you like best about your job?

The best part of my job is to see the team we've recruited for Vahterus China grow up so much over the years, in both professional skills as well as team work spirit and drive for excellence. My role is to develop our business for Vahterus in China, and the starting point is to develop people. I truly believe that when our attitude and mindset is right, results will follow.

How is your typical day at work?

As a manager, a day seldom goes by without decision making, big or small. A typical day for me would be a mix of different activities: interacting with our clients and prospects, and coaching and discussing with our team on how to solve issues we meet that day. In addition, I interact with our headquarters in Finland about on-going projects.

When do you feel you have succeeded in your work?

I've been working for several different Finnish companies, in different industries, and in different roles. From headquarter to frontline, from marketing to sales, from mass produced components to customised industrial products. I feel my achievement has been the ability to adapt to different environments, to be a team player and my desire to learn new skills.

What kind of situations bring out your best qualities?

I think life experience makes people who they are. Living in different countries and cultures has made me quite culture-sensitive. I have been equally influenced by Asian and Western cultures, so I've become good at cross-cultural communication.

What is the most important value Vahterus holds?

The fact that Vahterus is a family owned company. We're all Vahterus family members. The sense of belonging is very strong, and we have many employees who've served a long tenure at Vahterus.

If you weren't doing this job, what would you be doing?

My first job was a university teacher. It was totally not planned that I entered the business world and began managing an engineering business. So if life had left me on the original track, I'd most likely still be a teacher, maybe a professor by now.

How do you spend your time outside work?

I do some yoga, and I want to take up drawing, but I haven't been able to fully focus on that. I like reading biographies. I find stories of famous or ordinary people equally interesting. Meditation is my way of relaxing.

In the midst of everyday life, what delights you?

I appreciate every day that goes by and everyone I encounter. That is part of my life experience. Life is full of ups and downs, so I'm taking it calmly. I'm grateful that I have a very supportive husband, a very kind-hearted and intelligent daughter, and my extended family members are all loving and caring people.

What has impressed you recently?

On a recent business trip, I watched the movie called *The Post*. Based on a true story, the movie stars Meryl Streep as Katharine Graham, the first female publisher of a major American newspaper. Graham is a kind lady who isn't trained to run a newspaper but inherits a family business that she tries to run the best she can. When she has to make a tough decision whether to safeguard press freedom against government wrong doings, she takes the right course, risking losing everything she has – her business, her friends... It requires tremendous courage. That courage deeply moved me.

Which new skill would you like to learn?

Drawing or photography.

What do your co-workers not know about you?

I have an Asian face but I think much like a Finn.

Who of your co-workers would you like to praise?

I thank my boss and our CEO **Mauri Kontu** for his trust and support over the years, and his ingenious sense of humour; my colleagues in Finland who patiently taught me about Plate & Shell heat exchangers, and my team in China for being so hard working, supportive and eager to grow.

Case Stories

Colonial Pipeline Runs Between the Gulf Coast and the New York Harbor Area

Jonathan Pascoe, President of Vahterus Americas

Colonial Pipeline, headquartered in Alpharetta, Georgia, is the largest US refined products pipeline system and can carry more than three million barrels of gasoline, diesel and jet fuel between the US Gulf Coast and the New York Harbor area. The company was founded in 1961 and construction of the pipeline began in 1962. The pipeline is 5,500 miles (8,850 km) long. Colonial own the pipeline but no gasoline; they act as a carrier (just like DHL or UPS).

The pipeline, originating at Houston, Texas, on the Gulf Coast and terminating at the Port of New York and New Jersey, travels through the coastal states of Texas, Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, Pennsylvania and New Jersey. Branches from the main pipe-

line also reach Tennessee. It delivers a daily average of 100,000,000 US gallons of gasoline, home-heating oil, aviation fuel and other refined petroleum products to communities and businesses throughout the South and Eastern United States. The pipeline serves airports, military bases and the Department of Defense, and is regulated by almost every industry since the pipeline crosses many state lines.

The main lines are 40 inches and 36 inches in diameter, with one primarily devoted to gasoline and the other carrying distillate products such as jet fuel, diesel fuel and home-heating oil. Fifteen associated tank farms store more than 1.2×10^9 US gallons of fuel and provide a 45-day supply for local communities.



Vahterus heat exchangers successfully installed and running as per the customer requirements with operational performance data matching the design.

Field operations are divided into three districts:

- The Gulf Coast District, which includes Texas, Louisiana and Mississippi, and is primarily responsible for the originating deliveries of Colonial. Colonial primarily draws products from refineries along the US Gulf Coast. It also uses a few refineries in the Northeast.
- The Southeast District, which includes Alabama, Tennessee, Georgia, South Carolina and North Carolina. The company's second-largest tank farm is in suburban Atlanta. Local supplies are delivered from here, and it is the origin of pipelines serving Tennessee and southern Georgia. The company's largest tank farm is in Greensboro, North Carolina, where the two mainlines originating in Houston terminate. Deliveries to the Northeast originate from Greensboro.
- The Northeast District, which includes Virginia, Maryland and New Jersey. Colonial's Northeast operations also serve Delaware and Pennsylvania. In Linden, New Jersey, Colonial operates the Intra-Harbor Transfer system, which enables numerous customers to transfer products between themselves and access barge transportation for exporting product.

Colonial connects directly to several major airports, including Atlanta, Nashville, Charlotte, Greensboro, Raleigh-Durham, Dulles and Baltimore-Washington. It serves metropolitan New York airports via connections with Buckeye Pipeline. At the company's second-largest tank farm in Austell, GA, it was highlighted in early 2016 that there were four Shell & Tube exchangers that were causing maintenance headaches and becoming a cause for concern. These exchangers were originally installed in 1978 and their function was to cool the full pipeline flow of gasoline and ensure that the product stayed below the flash point, notably in the warmer months of the year.

Cooling-tower water is used to cool the gasoline. An engineering task team, led by **Rick Arnold**, Engineering Director of Colonial Pipeline, started to evaluate options, and Vahterus Plate & Shell Heat Exchangers (PSHEs) were highlighted as an alternative to the existing Tubular exchangers. Arnold had experience of PSHE technology through installations dating back to 2005/2006, which had run very successfully in the Atlanta area, and thus he had proposed PSHE as a good option for this application. **Vishal Kandachiya**, from the Engineering Services

Team in Alpharetta, GA, was tasked as Lead Engineer to make the evaluation, which would then be presented to the team on site, in Austell – notably, to **Steve Walsh**, the Project Manager.

Vahterus received a call into the Charlotte, NC office in February 2016 with the design scope. The same week, Jonathan Pascoe, President of Vahterus Americas, and Tuomas Aikkinen, Key Account Manager from Vahterus Finland, who happened to be in the USA at that time, attended an initial meeting with Mr Kandachiya in Alpharetta, GA. During this meeting, Vahterus PSHE was further introduced to Colonial, as well as the initial exchanger design basis. Based on the pipeline flow rates, the solution involved multiple exchangers of appreciable size.

After various design revisions and much discussion, the decision was taken to award Vahterus the work, but the project was under a significant time constraint. A purchase order was placed in July/August 2016 and delivery of the exchangers to site was required by January 2017. This meant that they had to be shipped from Finland before Christmas of 2016 to allow the site sufficient time to install them by May 2017, and certainly before the critical/warm months of the year.

The Vahterus team in Finland, led by **Anna-Leena Huhta-Aho** (Project Manager) and **Henri Kärmeniemi** (Senior Designer), were tasked with achieving the desired delivery and working through the detailed design. At the same time, **Jonathan Pascoe**, with the aid of **Marko Rantala**, Process and Chemical Business Director (Vahterus Oy) and **Tuomas Aikkinen**, continued discussions with the Engineering and site team at Colonial Pipeline. Within the given timeframe, all aspects of the installation needed to be detailed and carefully considered, notably the need for full maintenance capability, as well as full isolation of each exchanger. Accessibility was also a key factor, to ensure that in any eventuality, operation would never be compromised.

As promised, the exchangers were dispatched from Finland in December 2016, arriving in Austell, GA, in late January 2017. Colonial broke ground in February 2017. This had its own complications. Since the original installation dated back to the 1970s there were no detailed drawings for the underground pipework associated with the gasoline and cooling-tower water network at the junction. Therefore, the area where the exchangers were to be installed needed to be manually dug out – no small task given that it was around the size of a football field and the depth required was approximately 6 feet.

The dimensional accuracy of the exchangers, the foundations and the pipework needed to be exact, but due to the hard work of all concerned, the installation ran smoothly. All was operational in May 2017, meaning the project had been completed on schedule and everything was ready for the cooling season, to ensure that the gasoline temperature was maintained at an acceptable level.

Four Vahterus PSHEs Type 14HH-912/1/1 installed in parallel are now used to cool the gasoline from 120 to 99.5 F using cooling-tower water at 89 F. Working alongside the Colonial Team, Vahterus provided commissioning support and guidance to ensure that all was performing correctly. The results from the on-site analysis showed that the exchangers were operating as per the design,

notably in terms of the pressure drop, which is a remarkable achievement since 600,000 barrels of gasoline pass through this junction and the exchangers each day.

In February 2018, Vahterus's senior management team, including **Mauri Kontu**, CEO of Vahterus Oy, visited the installation site in Austell as follow up, after the exchangers had been in service for one cooling season. Operations personnel, as well as the project team from Colonial, presented their thoughts and experiences, being very pleased with the performance of the exchangers.

Given the tight time frames of the project, the delivery schedule, as well as the exacting performance expected of the equipment, it was agreed by all that the project was a great success.

Case Stories

Fast delivery of Hastelloy Heat Exchangers to Kisuma Plant in the Netherlands

Krista Karjala, Key Account Manager at Vahterus

Kisuma Chemicals produces high-purity synthetic magnesium compounds and is one the world's largest manufacturers of synthetic hydrotalcite. It's located in the northern part of the Netherlands and is a subsidiary of the Japanese Kyowa Group, the first company in the world to succeed in the industrial synthesis of hydrotalcite.

Vahterus's representative, Kapp Netherlands, contacted us with an urgent request for two heat exchangers for Kisuma's plant in the Netherlands. These product coolers would replace old spiral heat exchangers, which were broken and unable to support the production needs of the plant. The most critical issue was the delivery time. Installation of the new units needed to take place within a month, during a production shutdown. The order was further complicated because the requested heat exchangers were not standard. The product being processed at Kisuma's plant is highly corrosive, with hastelloy C-22 the

only applicable material for the product side. The highly corrosive and viscous product (> 100 cP) needed to be cooled to around 100°C using process water, with the design requiring a Size 5 PSHE using C-22 hastelloy plates and a stainless-steel shell.

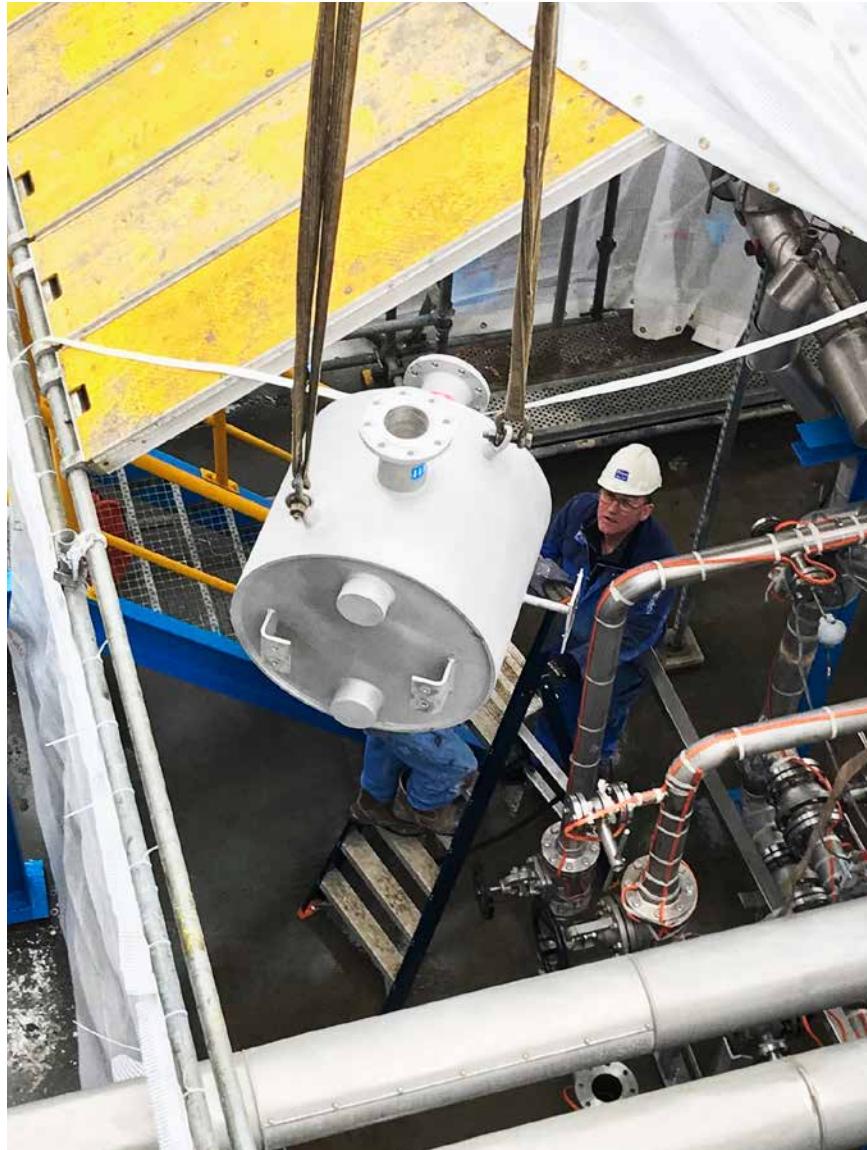
After receiving the enquiry, Vahterus checked the current stock levels of C-22 plates and there were exactly the right amount in stock. The rate limiting lead-time items then became the hastelloy flanges. Kapp Netherland provided contacts in the Netherlands allowing the flanges to be ordered quickly. They arrived at Vahterus's factory just in time to fulfil the production schedule. To put these events in real time, Vahterus received the enquiry on a Wednesday; the offer was sent to Kapp Netherlands the same day, with further detail provided the following day. On Friday, Kapp negotiated with Kisuma and was able to confirm the order. Detailed engineering commenced im-

mediately and was completed one day after receiving the order, whilst also meeting the customer's needs for minimal layout disruption. The design was approved only a few hours after receiving the documents, and the pressing of the heat transfer plates started directly after receiving the purchase order. From receipt of the purchase order to dispatch, the delivery time was exactly 31 days.

The heat exchangers were shipped from Finland to the Netherlands in less than two days. Installing the units required special equipment and tools. The compact size of the PSHEs was a key success factor, allowing for expedient installation. All documentation was received by Kisuma the same day as the heat exchangers arrived, ready for Lloyd's inspection and subsequent commissioning.

Finally, the units were insulated. Without dedication and excellent cooperation between all parties, the 31 day delivery would not have been possible. Project engineers at Vahterus and Kapp Netherlands maintained continuous contact with Kisuma throughout the process, providing photos and updates of the production process, almost every second day. In anticipation of the arrival of the heat exchangers, Kisuma built onsite dummies for prefabrication of the associated piping. All information was smoothly communicated between the three parties, allowing for a successful execution and completion of the work.

After six months of operation, Kisuma confirms that it is very satisfied with the heat exchangers, and that they are performing well within the production process.



Note from Ray Nahar, Project Engineer at Kapp Nederland:

"On behalf of Kapp and the end-customer, I sincerely thank Vahterus's project team for their commitment and proactive efforts in ensuring that everything happened according to plan. Making challenges like this happen, in the real world, makes me proud and happy to work with Vahterus."

Installing the Vahterus PSHEs at Kisuma Plant required special arrangements.

Case Stories

NH₃ Recovery System in Richards Bay, South Africa

Brandon Loots, Managing Director at Zonke Engineering

Omnia Limited is a manufacturer of chemicals and specialist products for the chemical, mining and agricultural industries.

The Omnia industrial complex is situated in Sasolburg, Free State, in South Africa, and consists of a nitric acid plant, ammonium nitrate (liquid) plant and porous ammonium nitrate (solids) plant.

Within this complex, the most important and primary feedstock for the production of nitric acid and ammonium nitrate, is ammonia. Omnia's nitrate and ammonium plants in Sasolburg are supplied with imported ammonia and Omnia operate an ammonia off-loading station in Richard's Bay, KwaZulu-Natal North, a few kilometres from the Richards Bay Harbor.

The economiser, droplet separator, oil coolers and condensers for the ammonia off-loading station in Richard's Bay were manufactured by Vahterus and supplied to a refrigeration specialist company, Howden Africa, through Zonke Engineering South Africa. The Engineering, Procurement and Construction Contract (EPC) was originally the responsibility of ThyssenKrupp Industrial Solutions India (TKIS-India), with the contract later transferred to ThyssenKrupp Industrial Solutions in South Africa (TKIS-SA).

TKIS-India initially specified Shell and Tube (S&T) heat-exchanger technology for the ammonia recovery system. TKIS-SA, in consultation with Zonke Engineering, the local agents of Vahterus in Sub Saharan Africa, reviewed the heat-exchanger technology and switched to Vahterus Plate & Shell Heat Exchangers (PSHEs) due to the significant cost, schedule and performance benefits that PSHE can provide vs. Shell & Tube in this application.

TKIS-SA and Howden Africa have many years of experience in using Vahterus PSHE technology, formerly introduced to them by Zonke Engineering.

The key benefits of using Vahterus PSHE for ammonia recovery systems:

- Compact design and significant space-saving in the skid assembly
- Higher performance efficiency due to true counter-current flow and reliable operation
- Lower investment costs compared to Shell & Tube heat exchangers
- Ease of maintenance, with a lower maintenance frequency
- Lower total cost of ownership.
- A much lower weight exchanger compared to a conventional S&T Heat Exchanger
- Ease of transportation and installation on site
- Shorter scheduled delivery than S&T



Vahterus oil coolers (PSHE 4HH-264/3/1 Openable Model) for Omnia's NH₃ recovery system in Richards Bay.

Case Stories

Vahterus Supplies PSHEs to thyssenkrupp Industrial Solutions's Urea Plants

Krista Karjala, Key Account Manager at Vahterus

The thyssenkrupp Industrial Solutions has been engineering and building nitrogenous fertiliser plants, based on technology developed by Uhde, for about 90 years, and is a leading supplier in this field. Since 1994 alone, thyssenkrupp Industrial Solutions has provided new ammonia plants, which provide a total production capacity of over 14 million metric tons, as well as upgrading nine existing ammonia plants.

One of the key applications for thyssenkrupp Industrial Solutions is urea plants. Urea is formed by reacting ammonia with carbon dioxide. The urea production process consists of synthesis, recirculation, evaporation, desorption, hydrolysis and granulation. Vahterus Plate & Shell technology is used in the desorption and hydrolysis aspects of the process.

In the hydrolysis part of the procedure, urea and ammonia are removed from process water in order to recycle all the feed components and subsequently re-use the decontaminated water. With the help of the hydrolyser/desorber, all components can then be reused in the plant, which of course optimises the efficiency of the process.

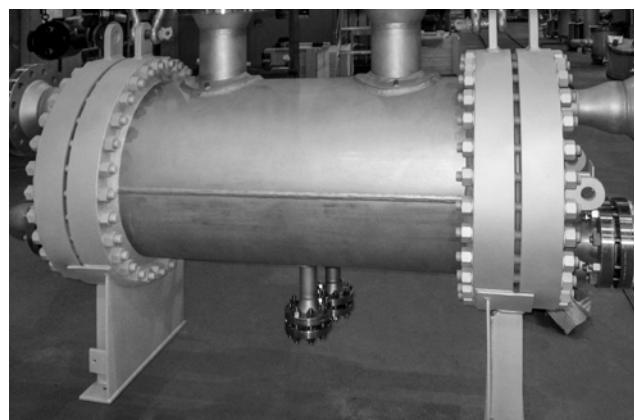
Vahterus heat exchangers are supplied as a standard component in the design of thyssenkrupp Industrial Solutions urea plant. An exchanger is installed between the desorber and hydrolyser. In this ammonia-water cross-heat exchanger, the ammonia water from the hydrolyser is cooled down with ammonia water going to the hydrolyser. The PSHE solution is a double-ended openable model with circulation pipe, which allows for accessibility to the exchanger internals whilst allowing for a multi-pass solution. The multi-pass solution is required, since the temperature profile of the application is very challenging, with a small LMTD and close approach temperature of the streams.

Vahterus has cooperated with thyssenkrupp Indus-

trial Solutions since 2012, and has supplied multiple exchangers for this application. The first unit was supplied to a urea plant located in Turkmenistan, following which there have been installations in the Netherlands, USA, Egypt and Algeria, to name a few of the installations.

When processing ammonia water, there are high demands for safety and inspection in the plant. Therefore, only welded heat-exchanger solutions are considered in this application. Originally Shell & Tube heat exchangers were used, but the systems were very large, often requiring multiple exchangers. Utilising Vahterus's PSHEs, thyssenkrupp Industrial Solutions has been able to supply a more compact solution at a lower cost.

The thyssenkrupp Industrial Solutions, and its customers, are very satisfied with PSHE in this application, with the exchangers meeting all process requirements as well as providing excellent reliability. The oldest unit has been in service for more than 15 years.



A Vahterus PSHE solution at a thyssenkrupp's urea plant – a double ended openable model with circulation pipe.

Vahterus's PSHEs Meet INERATEC's Demands for Effective Heat Recovery

Dr. Tim Böltken, Founder and Managing Director at INERATEC

INERATEC packages compact chemical plants into containers, in which Fischer-Tropsch fuels and chemical materials are produced efficiently from various gases. Offering compact chemical systems for Gas-to-Liquid, Power-to-Liquid and Power-to-Gas processes, INERATEC utilises innovative technology, based on compact microstructured chemical reactors. These enable the integration of an entire chemical plant into transportable containers. Their compact reactor technology allows dynamic, safe and efficient operation of highly exothermic and endothermic chemical reactions, such as Fischer-Tropsch synthesis. Significant competitive advantages arise due to the decentralised scale, with INERATEC providing services ranging from engineering and construction to the commissioning and maintenance of the units.

In the INERATEC Gas-to-Liquid, Power-to-Liquid and Power-to-Gas processes, the compact and intelligent design of heat exchangers is essential for high thermal

efficiency. Heat recovery and compact heating, as well as cooling at different points within the synthesis process are key design features in the container-sized plants.

One example of the successful integration of Vahterus PSHEs into an INERATEC chemical plant design is the Power-to-Liquid process currently operated at INERATEC's site in Karlsruhe, Germany. Prior to this, in 2017, this technology was successfully trialled in field tests in Helsinki and Lappeenranta, Finland, with Vahterus's partner, VTT Technical Research Centre of Finland.

In the Power-to-Liquid process, CO₂ and renewable H₂ are converted in a two-stage synthesis process to produce liquid Fischer-Tropsch fuels, as well as valuable chemical products. In the first step, CO₂ and H₂ are converted in a Reverse Water Gas Shift reactor into a synthesis gas mixture. The following FT reaction step then converts the synthesis gas into the desired chemical products.

The most important demands of heat exchangers in this process, within the containerised unit, are compact size, the ability to process the streams at high temperatures up to 500°C and high pressure up to 30 bar. Additionally, the heat exchangers must be durable and reliable, due to the flammable gases, such as H₂ and light hydrocarbons, that are present in the synthesis process.

INERATEC decided to use six Vahterus PSHEs for the Power-to-Liquid demonstration plant, to provide efficient and compact heating and cooling at different points in the process. Vahterus PSHEs provide highly efficient and safe operation within the containerised chemical plants.

INERATEC looks forward to the continuation of its successful partnership with Vahterus on upcoming projects. PSHEs meet the INERATEC's high demands for process efficiency and effective heat recovery. For upcoming larger scale Power-to-Liquid units, INERATEC has already ordered further Vahterus PSHEs.



INERATEC used six Vahterus heat exchangers in their Power-to-Liquid Hot Box.

Case Stories

Chinese Edible Oil Refinery Plants Operate with Vahterus's Heat Exchangers

Tracy Hakala, Managing Director for China, Australia and New Zealand at Vahterus

China is famous for its wide variety of culinary options and flavours. An important element in Chinese cooking is the oil in which the dishes are prepared. With 1.38 billion people's appetites to satisfy, China is one of the biggest edible-oil refinery centres in the world. In the Tianjin area alone, 4,600 tons of soya beans are processed each day. The process in an edible-oil refinery includes four main steps: degumming, neutralisation, bleaching and deodorisation. Edible oil deodorisation is carried out on an industrial scale using different methods (continuous, semi-continuous or batchwise) with the process requiring the vegetable oil to be heated to approximately 230°C.

Commonly, the oil resulting from the deodorisation process is used to preheat the incoming oil for odour removal, thus requiring a heat exchanger to economise the process. In this application, due to high operating temperatures, gasketed or brazed-type plate heat exchangers are not suitable due to their temperature limitations. Gasket replacement and oil leakage can lead to loss of production and revenue, which can amount to millions of RMB per day. In addition, oil spillage into the operating environment raises environmental and safety concerns.

Vahterus's PSHE is highly suitable for use in the edible-oil deodorisation process. The PSHE has the advantage of combining the high-heat transfer efficiency of a plate-type heat exchanger with a fully welded construction, which eliminates the use of gaskets. This provides a much more robust and durable solution, all contained within a pressure vessel.

Through close cooperation with our partner, Oiltek Oil & Fats Engineering (Shenzhen) Co, Ltd, Vahterus's fully welded PSHEs have helped the leading edible oil-refinery plants improve their energy and operational efficiency. Today, in the main edible oil production bases in Tianjin, Shanghai and Dongguan, Vahterus PSHEs are running safely and reliably 24/7.



Vahterus PSHEs operating at a global leading edible oil producer in Shenzhen, China.



vahterus.com